PENNSYLVANIA GEOLOGY

THE PENNSYLVANIA GEOLOGICAL SURVEY
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COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

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ON THE COVER: Shingled beach, Lake Erie shoreline near Girard, Pennsylvania. Photo courtesy of R. E. Laudenslager.

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FEBRUARY 1974

FROM THE DESK
OF THE
STATE GEOLOGIST...

MANAGING OUR MOST VALUABLE RESOURCE

In a society that generally measures value in terms of dollars, Pennsylvania's most valuable mineral resource is not coal, with an annual production value of $800 million; nor is the highly coveted petroleum, now selling at over $10 per barrel crude; nor is it gold, produced as a byproduct from some of our mines and selling at over $100 an ounce. Our most valuable mineral resource is water. Selling at a typical figure of 70 cents per thousand gallons, water's prime value is demonstrated by the fundamental, basic reality that it is the one resource we absolutely cannot do without.

Blessed as Pennsylvania has been with tens of thousands of miles of flowing streams and rivers, an abundant rainfall of over 40 inches per year, and a ground-water (subsurface) supply that has rarely failed to give us an adequately producing well wherever we have drilled, our appreciation and respect for Pennsylvania's water resources has been meager. It has been taken for granted.

More recently our attention to water has been increasing, partly out of a growing awareness that all is not well with our water resources today, and a recognition that for the future there will have to be advance planning and well thought out management procedures if Pennsylvanians are to have adequate water of acceptable quality.

Primary emphasis to date has been on problems of water quality, in recognition of the need to safeguard the health of man and the biological environment. Thus, the Commonwealth has achieved leadership with its programs for promoting proper sewage treatment facilities and for cleaning up thousands of miles of streams stricken with acid mine drainage pollution. The 500 million dollar bond issue approved a few years ago by the citizens of Pennsylvania, rigorously enforced new mining laws, and the improved Clean Streams Act, were major steps toward water quality improvement.

Still facing the Commonwealth is the need to implement measures to assure our complex society of adequate quantities of water. The demands on Pennsylvania's water quantity have been steadily increasing. We are using more water in our homes. Our industries are increasingly consuming water for sophisticated new processing techniques; central air-conditioning in large public and industrial buildings is consuming huge quantities of water. Our growing number of power generating plants each consumes vast quantities of water, much of which is lost to the atmosphere in the case of nuclear power plants. As we install effective sewage treatment facilities,

Continued on page 16

INCREASED OIL AND GAS EXPLORATION IN PENNSYLVANIA

As a result of increased demand and increased prices, the exploration for new petroleum and the development of known reserves increased considerably in the Commonwealth during 1973. Most of the exploratory effort was for natural gas. A total of 96 exploratory wells were drilled during the year, discovering 17 gas pools, 7 gas fields and extending 17 producing areas. The discovery with the largest initial gas production (15,000 MCF) was the # 1 McLaughlin in Erie County discovering the McKean Field. As yet, this is the only productive Oriskany (Lower Devonian) well in the field. Several wells have been drilled in the area, but they have all been dry. Two Medina (Lower Silurian) sandstone discoveries in the southwest corner of Venango County were probably the most significant discoveries since they opened a large area northwest of a line running through the cities of Mercer, Tidioute, and Warren in northwestern Pennsylvania for possible Medina gas production. Since these discoveries, this area has been leased heavily and several wildcat wells are being drilled. A recent discovery of gas in the Oriskany sandstone in Somerset County by AMOCO's, # 1 R. J. Lambert, might open a large Oriskany producing area, but more drilling must take place before this discovery can be evaluated.

Development drilling in the gas fields increased considerably over that of 1972 with 412 gas wells completed compared to 264 wells in 1972. The average price for new gas is 45 cents per MCF (1,000 cubic feet) with gas in some areas of northern Pennsylvania being purchased for 60 cents per MCF.

Although the total number of successful oil wells drilled in 1973 was 511, or 3 less than in 1972, the current high price of crude oil has already begun to stimulate drilling. The new and stripper well crude oil prices per barrel in the different districts are $10.65 Bradford District, $10.28 Middle District,

$10.13 Southwest District, and $10.00 for a barrel of Corning grade crude in Crawford County, Pennsylvania. These prices should also stimulate additional enhanced recovery of oil in the Commonwealth.

The most promising method for stimulating increased recovery being used in Pennsylvania is the Maraflood process. Two projects are in operation in the Commonwealth. One of the projects started as a pilot project in a watered-out section of the Bradford field, McKean County where the test was conducted in the oil-wet Bradford Third sandstone which contains a paraffinic crude and lies at a depth of about 1800 feet. The pilot project was started in December, 1968 with a pattern of 0.75 acre and was operated until June, 1970. At that time the project was expanded to a 45-acre project consisting of 16 injection wells and 25 producers. Injection started in March, 1971 and is continuing. Although no data has been released on the project, it appears to be at this stage technically, but not economically, successful. With the aforementioned crude prices now in effect, the economics should look more favorable. A long awaited paper on this project is to be presented in the Spring of 1974 in Tulsa at the SPE annual meeting.

A second Maraflood project was started in May, 1971 in the water-wet First Venango sandstone occurring at a depth of about 500 feet below the surface. This project is in the Goodwill Hill area of Warren County. It consists of four one-acre five spots with nine injection wells, four inside producers, and eight outside producers, covering a total of 10 acres. The First Venango sandstone in this area had been gas driven but never waterflooded. The crude oil in the reservoir is also paraffinic. Some problems were encountered and this project was shut down for several months. The project is now again under full operation.

At the writing of this article, several interesting deep tests are drilling in Pennsylvania. In Crawford County 6 wells are testing the Medina 6 miles southwest of Meadville and 12 miles south of the Indian Springs pool which is the nearest Medina production. In Fayette County a deeper pool wildcat is testing the Tuscarora (Medina) 8 miles south of Uniontown. A deeper pool test to the Upper Silurian has been staked in McKean County about 3 miles southeast of Clermont. In Potter County 2 wells are being drilled in the so called Oriskany no sand area to test the Oriskany interval. One is located about 5 miles north of the possible Oriskany pinch-out area and the other about 2 miles north. Two wildcats in Somerset County are going to test the Oriskany. A third wildcat, located about 13 1/2 miles southeast of Connellsville is fishing at 9257 feet and is projected to drill to the Cambrian at 20,500 feet. Another Cambrian test is located in Tioga County about 2 1/2 miles southeast of Marshlands where the well is being reamed at a depth of 13,517 feet. Its projected depth is 5,300 feet. A deeper pool wildcat in Venango County located near Franklin has been drilled to a total depth of 6085 feet and is being tested after fracturing the Medina.

William S. Lytle

BUT IS THERE REALLY A SLIPPERY ROCK?

The fame of the Slippery Rock football team, the Rockets, dates back to 1936, when a playful sports writer "proved" that this team deserved the title of Best in the Nation. The Rockets beat Westminster 14-0, which beat West Virginia Wesleyan 7-6, which beat Duquesne 2-0, which in turn beat Pittsburgh 7-0, which beat Notre Dame 26-0, which beat Northwestern 26-6, which beat Minnesota 6-0.

The question, through the years, as Slippery Rock football scores are broadcast across the nation, has been, "Is there really a Slippery Rock?"

Slippery Rock State College was named for the town of Slippery Rock, which was named for Slippery Rock Creek. Town and college are located about fifteen miles northwest of Butler, Pennsylvania. Slippery Rock Creek originates near Murrinville in northern Butler County, circles around the town of Slippery Rock, is joined by Wolf Creek below Slippery Rock, tumbles down the scenic gorge through McConnell's Mill State Park, joins the Connoquenessing Creek before entering the Beaver River below Ellwood City — a distance altogether of about thirty-five miles.

One morning this spring I asked my husband, "Do you suppose there really is one special slippery *rock,* and, if there is, does anyone know where it is?"

I asked the right person. Bill Lytle is in charge of oil and gas studies with the Pennsylvania Geological Survey. "I have the information at the office," he said. "It's on an old map."

Seeing it on a map is one thing. Seeing it on location is another. On a Sunday in June we drove to Wurtemburg in Lawrence County and walked as close as we could get to the tangle of cliff and brush that lined the eastern bank of the creek just below the map location of "The Slippery Rock" on J. P. Lesley's Slippery Rock Creek map of 1864. Now, more than a century later, the meanders of the creek bed still match those on the map.

Bill approached the owner of the house on the east side of the creek just south of the Slippery Rock location according to the Lesley map. "I have reason to believe that the rock this creek was named for is just a few hundred feet upstream from here," he said to John Eicholtz.

"I've had people come here trying to sell me things, wanting to buy my horses, asking me questions — but you're the first person ever came here to tell me that I own the original Slippery Rock!" Eicholtz replied.

Bill asked if we might walk upstream and check it out by the map.

"The water's too high now. Walking would be plenty slippery. Come

back later — after we've had a spell of dry weather. Come back in September and I'll go along upsteam with you," Eicholtz suggested.

Between June and September Bill and I read all we could find of the area folklore. In Sipe's *History of Butler County, Pennsylvania,* we read of an incident dating back to the American Revolution. "Hassler, in his 'Old Westmoreland,' says that Slippery Rock Creek received its name from an incident that occurred while Brodhead's expedition was crossing this stream. The troops crossed the creek at a place where there were many large, smooth, level rocks in the bed of the stream. On one of these rocks, the horse of John Ward slipped and fell, severly injuring the rider. Then the soldiers are said to have called this 'branch of the Beaver' Slippery Rock."

But John Ward wasn't the first man to find the rocks slippery. Further in the same chapter: "The Moravian missionary, John Heckewelder, who was in the Slippery Rock region many years before the time of Brodhead's expedition, says that the Delaware Indians called this stream 'Wescha-cha-cha-pohka,' that is, a slippery rock."

Reading on, we learned: "On Hector St. John Crevecoeur's "Map of the Old West," published in 1787 — Slippery Rock Creek is designated as Riviere de la Pierre Platte...."

With all three names — Slippery Rock, Wescha-cha-cha-pohka, and

Pierre Platte (Flat Rock) — the singular is used. Is there a particular slippery flat rock, or are the rocks in the creek bed slippery and flat in a general sort of way?

Lesley, whose map and profile of a line of levels along Slippery Rock Creek is appended to the *Second Geological Survey, Special Report J on the Petroleum of Pennsylvania*, was State Geologist at the time of the report's publication in 1874. Lesley's information about the origin of the name of the creek probably came from old-timers in the area.

If it is a particular rock, what makes it so slippery? Ralston, in *Early Life Along the Slippery Rock,* noted that the rocks along the stream tend to collect and hold a quantity of mud — "Some would hold an inch of it, and sloping ice or soft soap was scarcely as slippery. One had to walk circumspectly to avoid falling, It was doubtless always called Slippery Rock. Whatever fanciful meaning someone may have given, it is not an Indian name. It was not named because one of Brodhead's men fell down in its water; the difficulty was to cross it at all without falling down."

So — back where we started — with a hint of an answer to another question. Why, of all the more or less slippery rocks along thirty-five miles of stream — why this particular rock? Brodhead's men were *crossing* the stream. Ralston says "The difficulty was to *cross* it at all without falling down." Could the Slippery Rock have been located at a ford — a place where Indians, early settlers, and soldiers, before there were bridges, crossed the stream on foot or horseback?

What should we expect to find in September when the creek would be low enough to allow passage to the Rock? Lesley, in his report, says: "The Slippery Rock, which gave name to this fine stream at the first settlement of the country, is a plate of sandstone lying in place on the east bank, about a mile above Van Gordon's bridge, where there was a natural exudation of petroleum."

Bill researched the following information: "This "Natural exudation of petroleum" or oil seep, was located in Lawrence County about a mile and a half north of Wurtemburg, along the Slippery Rock Creek, and was the reason the area was drilled originally for oil and gas. The oil seeped out of the Upper Connoquenessing sandstone at stream level. Wells drilled in the area found oil in paying quantities at approvimately 200 feet below stream level in the Shenango sandstone. The productive oil pay in the Shenango sandstone was named the Slippery Rock oil sand. The Lawrence well was probablay the first commercial well in the area, with an initial production of fifty barrels of oil per day, drilled soon after the Drake well. The oil field discovered by the Lawrence well was named the Slippery Rock oil field.

September. With Eicholtz guiding us, we hop carefully from stone to stone along a gently sloping stream bank. The east wall of the gorge rises

abruptly a few feet beyond the shoreline. There is no place to fall except into the creek. It is each-man-for-himself as we pick our footing in quiet concentration. I am carrying the 1874 collector's item, *Report J* with its 1864 map of Slippery Rock Creek — and wishing with all my heart that I had left it in the car.

The main difference in the terrain when we reach the Rock is, to my untrained eye, that, instead of hopping from slippery stone to slippery stone, we are standing now on one flat, gently sloping, moist rock. It is covered (as are the smaller stones) with algae and moss — that glistens with an oily-appearing iridescence. The sloping rock had been resistant to the rushing force of the stream and now provides the creek with a deceptively almost-level bank and bed. The exposed portion of the solid rock extends along the edge of the creek for at least 25 feet. The dampness that covers the rock comes from a trickle of water seeping from between strata of shale and coal along the wall of the gorge. For the length of the exposed slippery rock there is no dry bank to walk on — just the creek, the moist, sloping slippery rock, and the gorge. "Well, what did you expect?" I ask myself. "This is The Slippery Rock!"

"No," I hear Bill saying. "The iridescence adhering to the algae and moss is not oil. When oil on water is disturbed, it re-forms in one mass. The substance here, when disturbed, fragmentizes. This is an iron oxide film — not an oil film."

I've rough-sketched the picture. Bill can fill in the geological details. "Although no oil was seen seeping out of the sandstone, none was expected, since the gas pressure which used to force the oil out had been depleted long ago by the oil wells of the area. A sheen of color now seen near the contact of the Mercer and Upper Connoquenessing, was identified as an iron oxide film. The evidence points to this plate of rock as being that described by Lesley and designated at The Slippery Rock.

"From the description by Lesley of the location of the Slippery Rock, it is determined that it is just above the Glasser bridge on the Van Gorder road about one and a half miles north of its junction, at Wurtemburg, with Route 488. The Van Gordon (Van Gorder) bridge shown on Lesley's map is no longer standing. Above the Glasser bridge, for about three hundred feet, can be seen what appears to be shales and coals of the Mercer formation, extending from the edge of the creek, on up the steep hillside. At one place the underlying Upper Connoquenessing sandstone can be seen at stream level lying under the Mercer. This is apparently the "plate of sandstone lying...on the east bank," described by Lesley. It dips beneath stream level downstream before the stream reached the bridge."

Wallace notes in his *Indian Paths of Pennsylvania*, p. 82, that the Indian path, "the Kuskusky-Ohio Forks Path, from Pittsburgh to New Castle...crossed Slippery Rock Creek in the vicinity of Wurtemburg..."

Could this ford have been at the Slippery Rock described by Lesley? If so, then this particular rock — excessively slippery due to an oil seep at the point where the stream was forded on foot or horseback — could be the name Slippery Rock given to it by Indians and early settlers as a warning, "Cross here but watch your footing!"?

This isn't Plymouth Rock or the Rock of Gibraltar. But how many rocks have named a creek, a town, an oil field, an oil sand, a college, and a favorite football team?

The Rock is on the John Eicholtz property. It can be seen along the east bank of the creek from the Glasser bridge — or from the west bank, looking across and downstream, from the southern tip of Camp Allegheny, the Pittsburgh Salvation Army Camp. Most of the rock is under water. All of it is algae, moss, and mud-covered — treacherous, and beautiful in its rustic setting.

Virginia and William Lytle

GREATER PITTSBURGH AREA MAPS ON OPEN FILE

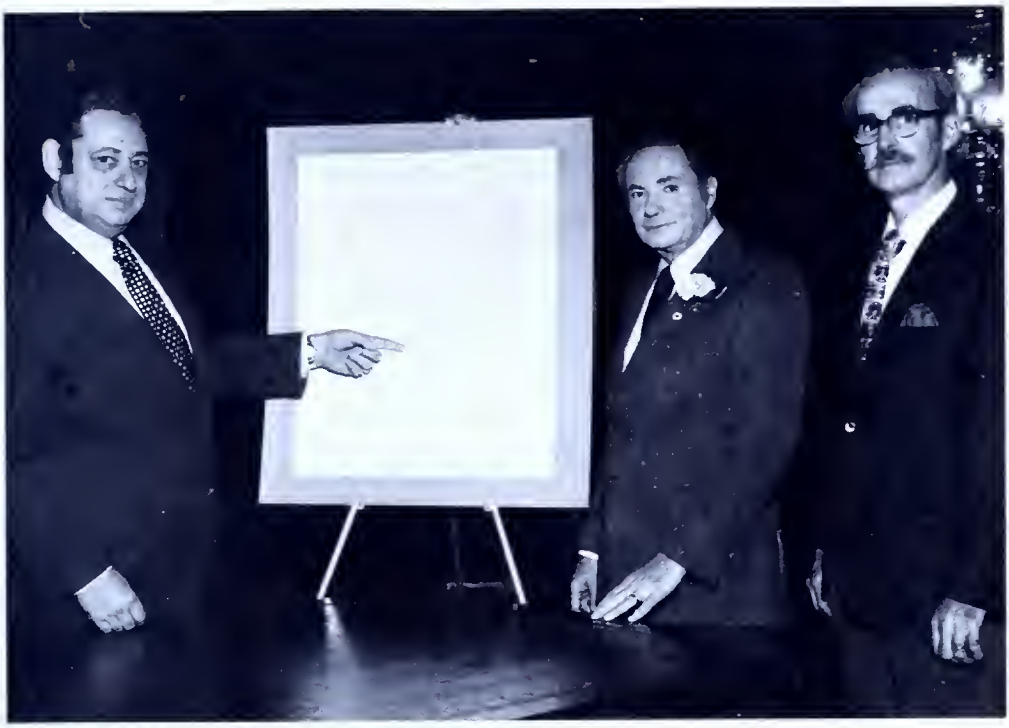
Structure maps, geologic maps, and Pittsburgh coal overburden maps of the greater Pittsburgh region at a scale of 1:24,000 have been placed on open file by the Pennsylvania Geological Survey. The individual maps correspond to the boundaries of the 7 1/2 minute topographic maps of Beaver, Butler, Allegheny, Armstrong, Westmoreland, and Washington counties. These maps have been drawn on mylar and are the work sheets from which regional maps at 1:125,000 will be published at a later date. The structure maps and geologic maps are revisions of published maps, based mainly on data from sub-surface and from surface mining operations indicated on the 7 1/2 minute topographic maps. The maps have *not* been field checked.

The structure maps are drawn on the top of the Vanport limestone in Butler, northern Beaver, northern Allegheny, southern Armstrong, and eastern Westmoreland counties; the base of the Pittsburgh coal in southern Allegheny, western Westermoreland, and Washington counties.

The geologic maps show the high level terrace deposits and the contacts of the Washington Formation, Waynesburg Formation, Monongahela Group, Conemaugh Group, Allegheny Group, Pottsville Group, Mauch Chunk Formation, and Pocono Formation. Discontinuous boundaries are indicated for the Ames limestone of the Conemaugh Group and the Vanport limestone of the Allegheny Group.

The Pittsburgh coal overburden maps show the 100, 200, and 300 foot thickness of rock above the Pittsburgh coal.

The maps may be *examined* at the Pittsburgh office of the Pennsylvania Geological Survey.



CELEBRATING TOPOGRAPHIC MAPPING MILESTONE

State Geologist Arthur Socolow is shown presenting to Governor Shapp the Union City Quadrangle topographic map, as Assistant State Geologist Donald Hoskins looks on. The completion of the Union City quadrangle marked the last of 764 quadrangle maps which now cover the entire Commonwealth of Pennsylvania. These maps are the result of a cooperative program between The Pennsylvania Geological Survey and The U.S. Geological Survey with additional support by the Pennsylvania Dept. of Transportation.

Even as statewide coverage has been completed, a revision program is underway to keep the maps up-to-date, particularly in fast changing urban and suburban areas.

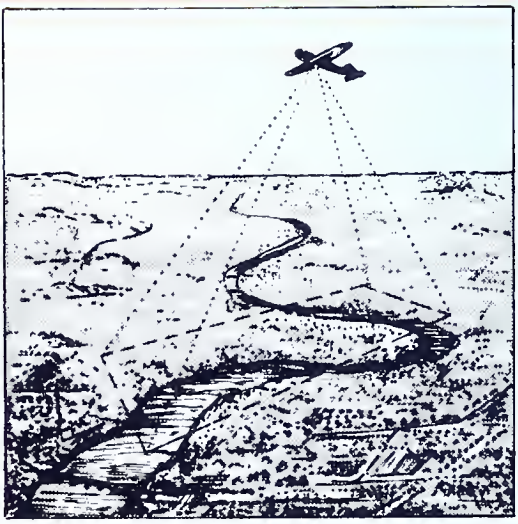
A detailed free index for all the topographic maps is available from:
Pennsylvania Geological Survey
Department of Environmental Resources
Harrisburg, Pa. 17120

U.S. Geological Survey
1200 S. Eads Street
Arlington, Virginia 22202

Topographic maps may be purchased from the U.S. Geological Survey office listed above, or from a number of retail outlets in Pennsylvania which are listed on the above-mentioned index.

SURVEY ANNOUNCEMENTS

AERIAL PHOTOGRAPH LIBRARY AGAIN AVAILABLE FOR PUBLIC USE



The Bureau of Topographic and Geologic Survey is happy to announce that we are again able to lend aerial photographs of Pennsylvania to anyone needing such information.

The library of the Bureau maintains two primary series of photographs for staff and public use. The first series is arranged by county and includes all counties except Philadelphia. Each county is covered by three sets: one flown in the 1940s, a second set flown in the 1950s and a third set flown in the 1960s. The southeastern counties also have coverage flown in the 1970s. All of these photographs are at a scale of 1:20,000 except for a 1:40,000 series flown for the northeastern counties in 1969. All of the county series are now available in the Bureau Library and may be signed out for limited periods through the Bureau Librarian, Mrs. Sandra Blust. These must be secured in person; mail or phone requests cannot be processed.

The second primary series of photographs are 1:30,000 scale photographs flown during the winter for use in preparation of topographic maps of Pennsylvania. These photographs are arranged by 15-minute quadrangle. Currently the Bureau has 70% coverage of the 1:30,000 winter photos and will have 100% coverage within a few months. As each quadrangle is revised, new photography is added to this series.

For those wishing to purchase personal copies of the photographs from the issuing federal agencies, the Bureau will supply ordering information. Photographs should be inspected in person in the Bureau library before ordering in order to get the necessary photograph numbers.

NEW OFFICES OF THE OIL AND GAS DIVISION

The Pennsylvania Survey's Oil and Gas Division has completed its move to new space in the Kossman Building, on Forbes Avenue, Pittsburgh. The Division offices are on the 12th floor, the sample library is on the 5th

floor of the same building, and their new sedimentation lab is on the 6th floor. Due to the weight limitations, the sample library was spread out onto more shelving to hold the well samples. An addition to the sample library is a diamond saw for cutting rock cores. The slabbing of the cores with the saw will reduce considerably the storage space needed for the core library which is located in the basement of the State Building just a block away from the Kossman Building.

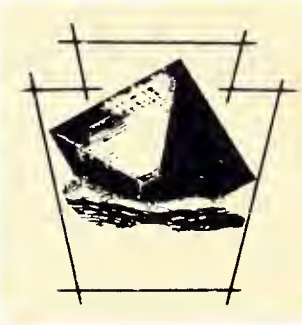
The move to the Kossman Building placed most of the Pittsburgh area units of the Department of Environmental Resources in the same building where intra-unit operation and administration will be handled more effectively and efficiently. The new address: Division of Oil and Gas, Bureau of Topographic and Geologic Survey, Department of Enrironmental Resources, Room 1201 Kossman Building, 100 Forbes Avenue, Pittsburgh, Pennsylvania 15222.

We designed our new quarters to give you better service. We will be glad to help you so let us hear from you by mail or a personal visit.

CHROMIUM AND NICKLE IN SOIL AS GEOCHEMICAL INDICATORS FOR CHROMITE DEPOSITS IN THE STATE LINE DISTRICT, PENNSYLVANIA

During the mid-1800's, chromite deposits of the State Line district in southern Lancaster County, Pa., and adjacent Maryland produced most of the chromite used in North America. The chromite bodies are pod-shaped to sack-form, relatively small in size (up to 100,000 tons) and range from massive chromite to layers of disseminated grains enclosed in a large alpine-type ultramafic body. Much of the chromite is of good metallurgical and refractory grade. Since 1880 the district has produced little chromite, but it seems likely that additional ore bodies exist under the thick soil and dense brush of the region. In order to test the applicability of soil geochemical techniques to exploration for additional chromite bodies, soil profiles and traverses across the mineralized zones have been studied at the abandoned Red Pit and Rock Springs Church mines. Of the elements studied (Cr, Ni, V, Co, Fe, Mg, Al), Cr and Ni show distinctly anomalous values in residual soils over the old workings. Chromium exists in the soil primarily as residual chromite grains with the highest concentration in the upper six inches. The highest nickel occurs in the deeper part of the soil profile and is concentrated in the clay fractions.

D.L. Pennington and A.W. Rose, The Pennsylvania State University



EARTH SCIENCE TEACHERS' CORNER

land-use planning unit at chambersburg area senior high school

INTRODUCTION

There is a serious lack of understanding among students and some teachers regarding land-use planning principles, both their value to the community and to the students who will soon become active citizens of the community. Some examples include: 1) Zoning laws and citizen debates over proposed land changes, 2) School locations selected without emphasis on reasons other than land availability, such as water availability and foundation stability, 3) Improper locations of sewage systems, and sanitary landfills, and 4) Building sites located on flood plains, in areas of major landslides, and over carbonate rocks known to collapse.

In all of the above examples, intelligent decisions need to be based on an understanding of the land's physical parameters.

RESOURCES

There is a wealth of information to assist the science teacher in this unit. The following were used in teaching the activities presented here:

1. Land Resources Map of the Commonwealth
   Published by the Pennsylvania State University, this map presents soil resources in a graphic form and brings together factors such as soil depth, drainage, available moisture, and the soil's productive capacities.
2. Soil Survey Maps
   Published by the U.S. Soil Conservation Service, the maps are often accompanied by a soil interpretation report. The maps are available on a county base and include many interpretations of the soil capabilities. The most valuable part is the section concerned with community development, recreational development, soil suitability for wildlife, and soil interpretations for woodlands.
3. Engineering Characteristics of the Rocks of Pennsylvania
   This is published by the Pennsylvania Department of Environmental Resources, Bureau of Topographic and Geologic Survey. This bulletin used with the State Geologic Map provides an introduction to geology and land-use planning.

4. Environmental Geology for Land-Use Planning

   Published by the Bureau of Topo. and Geologic Survey, written for planners and planning commissions, this publication provides basic geologic principles for planners including geologic hazards, choices and possible alternatives.

5. Additional Sources

   Topographic maps, geologic maps, field investigations, free publications of the Bureau of Topo. and Geologic Survey.

INSTRUCTIONAL PROCEDURES

The time spent on this unit usually averages three to four weeks if classes are scheduled daily. The unit may be introduced by a community resource individual such as a county agent, state geologist, or a regional planner. An alternative or additional procedure is to initiate a discussion of lack of community planning, or bad planning, and poor land-use. Examples may include: a) poor sewage drainage systems of private homes, b) buildings on flood plains, and c) sinkholes that develop on properties.

When the students have had an opportunity to examine their community's errors, they might work in small groups or pairs. Each student, or group, is then asked to identify an area in their county which they will investigate.

Students are then required to compile data concerning the physical properties of the rocks and soils and the suitability of the land for a variety of land-use practices. The following uses must be completed by each student for his identified plot of land.

1. Sewage effluent - disposal, percolation
2. Basement construction
3. Sanitary landfills
4. Recreation
5. Wildlife
6. Woodland
7. One additional land use selected by the student from a chart.

The procedure students follow for each of the above uses is to obtain and complete a small scale map - one for each land use or a total of seven maps. The following colors are used on the maps to code the regions of his selected area:

Red - (stop) - the soil or rocks are not suitable for that land use practice.

Yellow - (caution) - the soils and rocks are marginal for this land use.

Green - (go) - the soils and rocks are acceptable for this land use.

Once students have finished the seven maps, they can lay them out and immediately visualize the suitability (or unsuitability) of a particular portion of their identified land area for the specific land use in question.

The next activity is to complete a large scale map based on the small scale maps. This final completed map should only include those land uses that the

student feels are appropriate for the indentified area according to earlier data collection and map-making.

Evaluation of this project can take many forms but may be based on some or all of the following:

a. Suitability of student land-use recommendations according to the data collected.
b. Accuracy of student summarizations.
c. Neatness.
d. Promptness of effort, and similar considerations.
e. Analysis of current community problems as they can be traced to land-use violations uncovered in this unit of study.

Burt Waite
Former Earth Science Teacher
Chambersburg Area Senior High Sch.

new films

Earthquakes - Lesson of a Disaster (13 min.). The California quake of 1971 and the Gediz, Turkey, quake. AGI Encyclopedia Britannica Educational Corp., 425 North Michigan Ave., Chicago, Illinois 60611

Energy and All That (28 min.). Innovative film to bring out the urgency and complexity of the country's energy problems. American Petroleum Institute, 1801 K. Street Northwest, Washington, D. C. 20006

Geology - Lake Agassiz Region (27 min.). Landscape evolution of the Lake Agassiz Region. Cherry Film Productions, Ltd., 25 Bell Street, Regina, Saskatchewan S4S 4V7 Canada.

Geyser Valley (8 min.). Wide variety of geologic phenomena in Yellowstone National Park. AGI/Encyclopaedia Britannica Educational Corp., 425 North Michigan Avenue, Chicago , Illinois 60611.

Heartbeat of a Volcano (20 min.). Spectacular views of the build-up and eruption of Kilauea Volcano, Hawaii. AGI/Encyclopaedia Britannica Educational Corp., 425 North Michigan Ave., Chicago, Illinois 60611

Legacies of the Ice Age (12 min.). Comparison of continental and mountain glaciers and influence on North American land forms. Indiana University, Audio-Visual Center, Bloomington, Indiana 47401

Pogo. The Search for oil and gas offshore in the Gulf of Mexico. United Gas Pipeline Co., Public Relations Director, 900 Southwest Tower, Houston, Texas 77002

Origins of Man Series. Describing man's search for his beginnings.
1. Early Man in North America (12 min.)
2. From Homoerectus to Neanderthal (18 min.)
3. Ape Men of Africa (20 min.)
4. Civilizations of Ancient America (22 min.)
5. Who Discovered America? (14 min.)

Films, Inc.
1144 Wilmette Avenue
Wilmette, Illinois 60091

The Restless Earth Series. The geologic theory of plate tectonics.
1. Plate Tectonics Theory (58 min.)
2. Evidence from Ancient Life (28 min.)
3. Earthquakes (27 min.)
4. Geology and Man (20 min.)

Indiana University
Audio-Visual Center
Bloomington. Indiana 47401

San Andreas Fault (15 min.). AGI/Encyclopaedia Britannica Educational Corp., 425 North Michigan Ave., Chicago, Illinois 60611.

Santa Barbara - Everybody's Mistake (30 min.). Studies the oil spill at Santa Barbara in 1969. Indiana University, Audio-Visual Center, Bloomington, Indiana 47401.

This Land - Evolution of North America (18 min.). Shell Oil Company, One Shell Plaza, P. O. Box 2463, Houston, Texas 77001.

Volcanoes: Exploring the Restless Earth (18 min.). Spectacular film on volcanoes. AGI/Encyclopaedia Britannica Educational Corp., 425 North Michigan Ave., Chicago, Illinois 60611

Why do we still have Mountains? (20 min.). Struggle between leveling processes and deformation of the Earth's crust. AGI/Encyclopaedia Britannica Educational Corp., 425 Michigan Ave., Chicago, Illinois 60611

PENNSYLVANIA ACADEMY OF SCIENCE CELEBRATES 50 YEARS

The 50th anniversary meeting of the Pennsylvania Academy of Science will be held at Bloomsburg State College April 18-20, 1974. Highlights of the meeting will be sessions on biology, geology, physics, chemistry, and geography. For details, contact George C. Shoffstall, 214 Whitmore Laboratory, University Park, Pennsylvania 16802.

The Pennsylvania Academy of Science provides an opportunity for in-

dustrial, secondary education and collegiate scientific personnel to meet and to share scientific work being conducted in Pennsylvania. Through its junior academy, it also involves high school students in science programs.

continued from page 1

we are imposing additional heavy demands on water supplies. Pennsylvania's farmers are turning more and more to irrigation, calling for large quantities of water. And even in the field of recreation, we are imposing more demands on water quantity as we build more lakes for boating, swimming, and fishing.

As much as Pennsylvania has been blessed with abundant supplies of water, the supply is finite. There are limits within which we can satisfy the growing demands cited above. We now have to recognize and define what those limits are so that we may take the necessary technical and administrative steps to assure adequate water supplies in the right place, at the right time, for the right uses. This means water management, a term we are not yet used to, but one we will have to become more familiar with.

Water management must concern itself not only with the needs imposed by man, but also the catastrophic variations imposed by nature. Water management must cope with droughts, such as Pennsylvania suffered in the late 1960's, and with floods indelibly impressed upon us by Agnes. Man's needs, natural deficiencies, and natural excesses must all be integrated into comprehensive water planning in Pennsylvania.

Pennsylvania has made a start towards water quantity management. Our participation in the Delaware River Basin Commission, Susquehanna River Basin Commission, Ohio River Basin Commission, and Great Lakes Basin Commission is a good beginning. The Department of Environmental Resources is working on a detailed inventory of Pennsylvania's surface and subsurface water resources. Our Commerce Department, Department of Community Affairs, Agriculture Department, Public Utilities Commission, and Office of Economic Planning and Development, are developing data on the needs of Pennsylvania's water consumers.

Ahead lies the task of coordinating our varied needs with our limited water resources and defining the technical installations, practices, and restraints which we have yet to initiate. There will be a continuing need for accurate data and for sophisticated research to cope with the challenge. Pennsylvania is fortunate that it has made a timely start towards satisfying our water needs, and that capable leaders in state government, universities, industry, and private citizens are addressing themselves to the future of our most valuable resource, water.

Prepared for Pa. Dept. of Commerce Annual Report on Water

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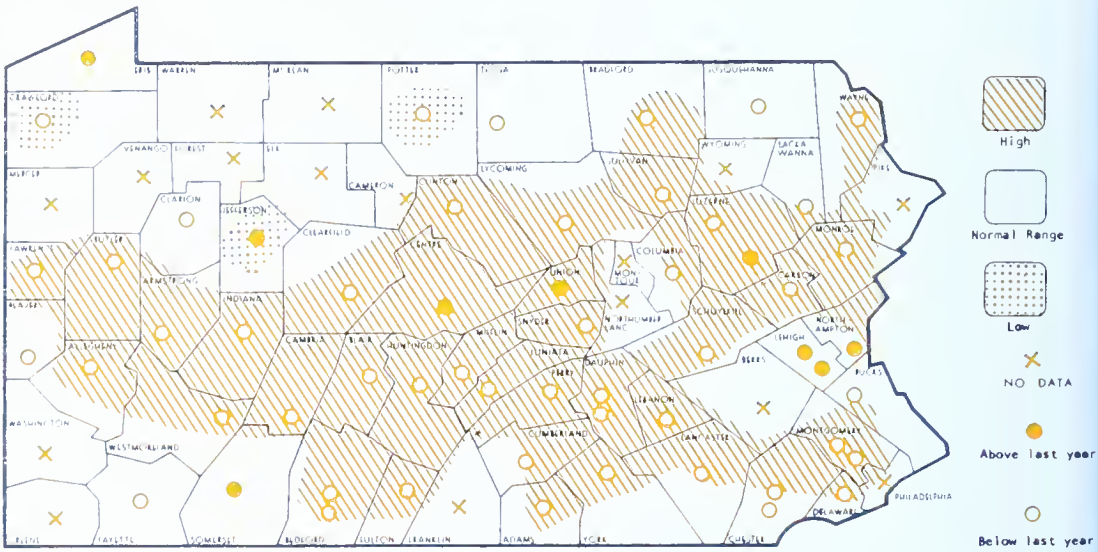
JANUARY 1974

GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120

PENNSYLVANIA GEOLOGY

THE PENNSYLVANIA GEOLOGICAL SURVEY

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Flagstone quarry in Lackawanna County. Photo courtesy of R. E. Laudenslager.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

APRIL 1974

FROM THE DESK OF THE
STATE GEOLOGIST . . .

WOULD YOU RATHER OWN A DIAMOND MINE OR A GRAVEL PIT?

Shortly after our wedding, my wife confessed that she married me because she figured that I might find her a diamond mine. I pointed out that she would be better off if I found a gravel pit! The simple fact is that while the U. S. has no commerical production of diamonds, the value of sand and gravel mined last year was $1.2 billion. The message here is that real value is not necessarily connected with glamour materials. In recent months our attention has been focused on prices and shortages of mineral fuels, and while there is also a growing concern over our increasing dependence on foreign sources of metallic minerals, there still is a surprising lack of awareness of the tremendous role which our non-metallic, industrial minerals serve in our economy.

Last year, while the total value of all metallic minerals produced in the U. S. (including gold, siver, copper, lead, zinc, manganese, etc.) totaled $3.5 billion, the combined value of all the non-metallic categories alone (stone, cement, sand and gravel) had a $4.2 billion production value, thus exceeding all metallic mineral production.

The importance of non-metallic mineral resources can further be demonstrated by per capita use data. In 1973 for every man, woman and child in the U. S. there was used 9,000 pounds of sand and gravel, 8,500 pounds of stone, 800 pounds of cement, 600 pounds of clays, 450 pounds of salt, 1200 pounds of other non-metals; this made a total of 20,550 pounds per capita of all non-metallic as compared with 1340 pounds of metals per person.

In Pennsylvania last year nearly 40 percent of the Commonwealth's $1.3 billion total mineral production value consisted of non-metallic industrial minerals: cement, stone, lime, sand and gravel, and clay.

These non-metallic minerals are called industrial minerals for the very reason that they are critical raw materials necessary to maintain our industrial capability and responsible for employment of great numbers of people. Non-metallics also provide the raw materials from which we construct our homes, offices, factories, roads, bridges, railroads, and airports.

With their great dollar value and importance to our society, we are fortunate that Pennsylvania and the U.S. have great reserves of the industrial minerals. We must, however, assure their future availability by carefully mapping their distribution, planning for their accessibility, and establishing mining procedures compatible with being good neighbors to our citizens and our environment.

Arthur A. Arndt

GROUND-WATER CONDITIONS CAUSED BY TROPICAL STORM AGNES

Ground Water — that usually invisible but important source of water, became a visable and unwanted water body in many places after the passing of tropical storm Agnes. Many homes, remotely situated from the surface flooding along streams and rivers, suddenly had indoor swimming pools in their basements as the ground-water table rose to record heights. Wells overflowed the surface, surface depressions became ground water lakes, and basement walls collapsed and floors heaved from the record high ground-water levels.

Ground water in the Susquehanna River Basin occurs in fractured-rock aquifers and in the unconsolidated glacial drift and alluvial aquifers. Unconsolidated aquifers are limited to that area in the northern part of the basin

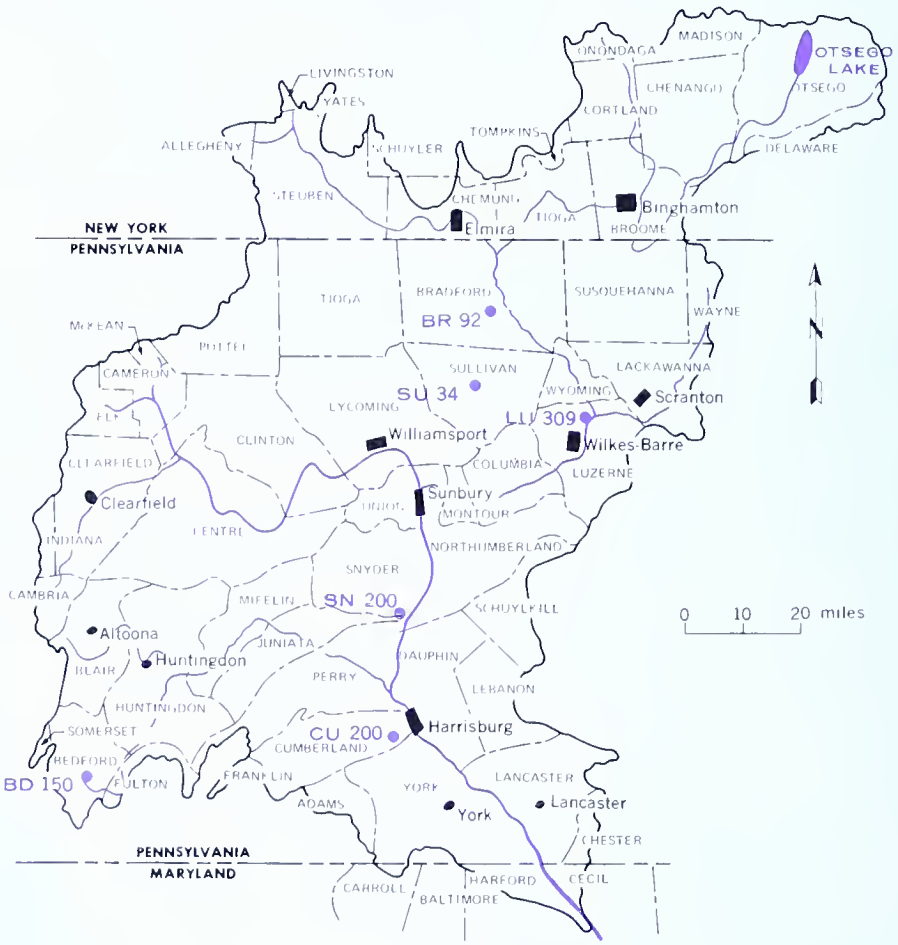


Figure 1. Map of Susquehanna River Basin showing location of observation wells and well number assigned by the U. S. Geological Survey.

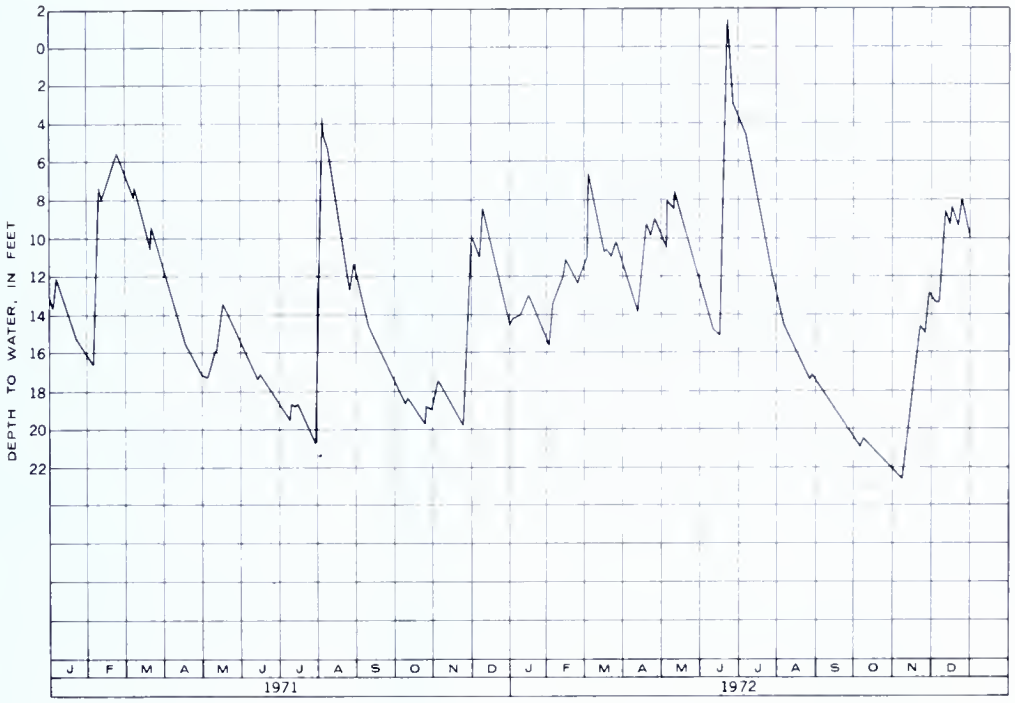


Figure 2. Water level hydrograph from well Cu-200, during 1971-72.

that was once covered by glaciers and to the alluvium along major stream valleys. Because of its occurrence along streams, the unconsolidated aquifer has a shallow water table and its level and fluctuation is affected by the stream stage. Whenever the stream channel is full the water table rises in response to the recharge from the stream, as well as to rainfall on the land surface. Consequently, those developed areas along flood plains are highly subject to ground-water flooding, even if they are not flooded overland.

Fractured rock aquifers are made up of a network of openings formed by intersecting fractures, solution cavities, and separations between rock layers. Most of the water-bearing openings are in the weathered zone and in the immediately underlying fractured rock. Normally the water table lies within the lower part of the weathered zone, or locally in the upper part of the fractured zone. The permeable soils permit much of the precipitation to infiltrate to the water table. The rocks have comparatively low transmissivity and their drainable void space decreases rapidly with depth. Therefore, under intense precipitation, such as occurred with tropical storm Agnes, water percolates to the water table faster than it is transmitted to points of discharge. Thus, the void spaces in the rocks are filled and the ground-water levels rise rapidly.

Hydrographs from U. S. Geological Survey observation wells, located throughout the basin, were analyzed to determine ground-water response

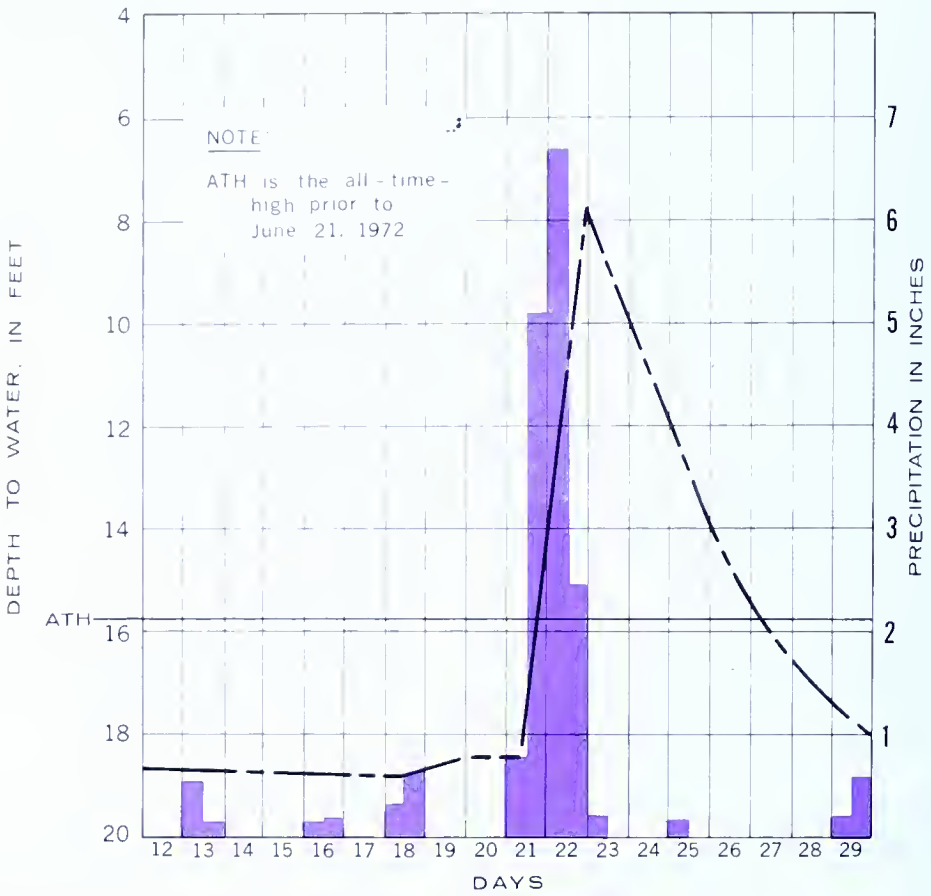


Figure 3. Water level hydrograph from well SN-130, and 12-hour precipitation totals at Harrisburg, Pa. during June, 1972.

to tropical storm Agnes. Locations of wells used as examples in this paper are shown on Figure 1.

The amount of water-level rise in an aquifer is dependent upon a number of factors, including: the amount and intensity of rainfall, soil and soil moisture conditions, and topographic setting. The amount and intensity of rainfall associated with the tropical storm was sufficient to create all-time-high water levels in most of the observation wells in the basin. The water levels in most of the wells were normal for June prior to the storm; however, soil moisture conditions were near saturation because the response to rainfall was immediate.

Had the pre-storm water level been below normal, the extent of ground-water flooding would have been reduced. For example, the record from a well in Cumberland county (Fig. 2) shows a rise in water level at the end of July, 1971 to be of the same magnitude as that recorded for the "Agnes" storm. However, the antecedent water level conditions were such

for the July, 1971 storm that the peak was 5 feet lower than that which occurred during the "Agnes" storm.

Topography greatly influences water-level fluctuations. Most of the basin has high topographic relief and is underlain by sandstone, siltstone, and shale. Water-level fluctuations in wells tapping these aquifers range from a few feet to a hundred feet, depending upon topography. Wells drilled on hillsides and hilltops fluctuate to a greater degree and have greater depth to water than those drilled in valleys. The following four hydrographs were selected to illustrate the effect of Agnes on water levels in each topographic setting. All the hydrographs were obtained from wells drilled in shale.

The hydrograph for a hilltop well, located in Snyder County (Fig. 3) shows about 12 inches of rainfall resulted in an 11-foot rise to a peak of 7.7 feet below land surface, which exceeded the previous all-time-high by 8.1 feet.

The hydrograph for a hillside well, in Bedford County, (Fig. 4) shows 5.7 inches of rainfall resulted in a 10-foot rise to a peak about 3-feet below land surface, which exceeded the previous all-time-high by 1.7 feet.

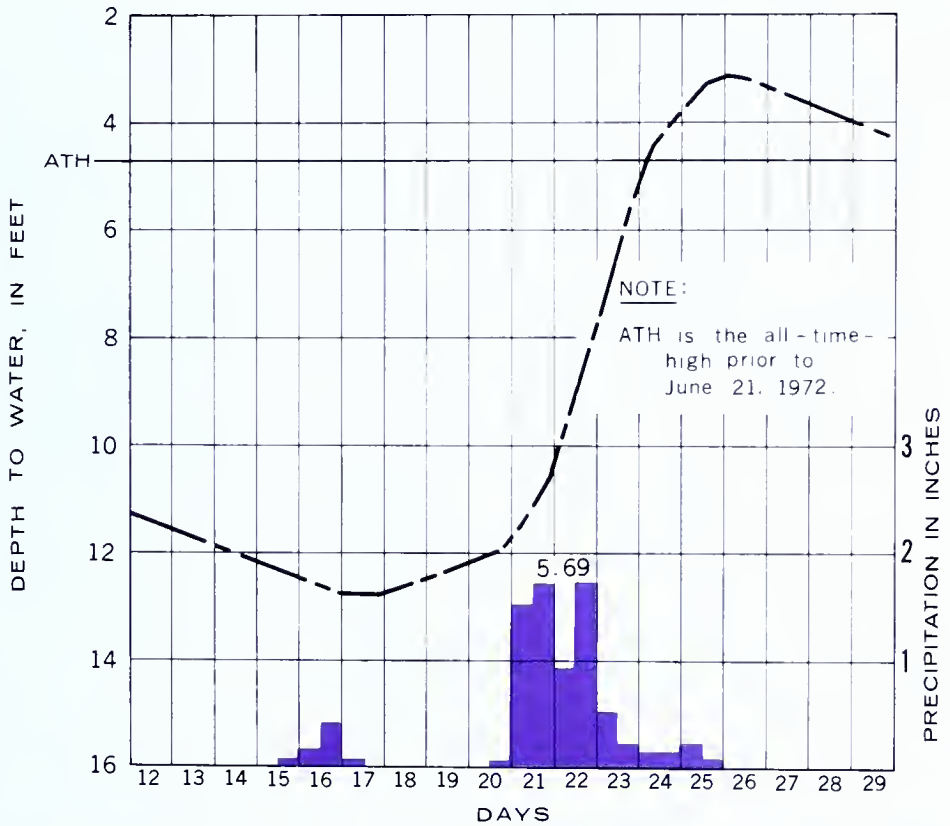


Figure 4. Water level hydrograph from well BD-150 and 12-hour precipitation totals at Everett, Pa. during June, 1972.

All water-levels in wells located in valleys rose to or above land surface. The water level in a well located near the headwaters of Little Loyalsock Creek in Sullivan County (Fig. 5) responded to 7.7 inches of rainfall by rising 20-feet to a peak about 6-feet below land surface. This water level exceeded the previous all-time-high by 11.5 feet.

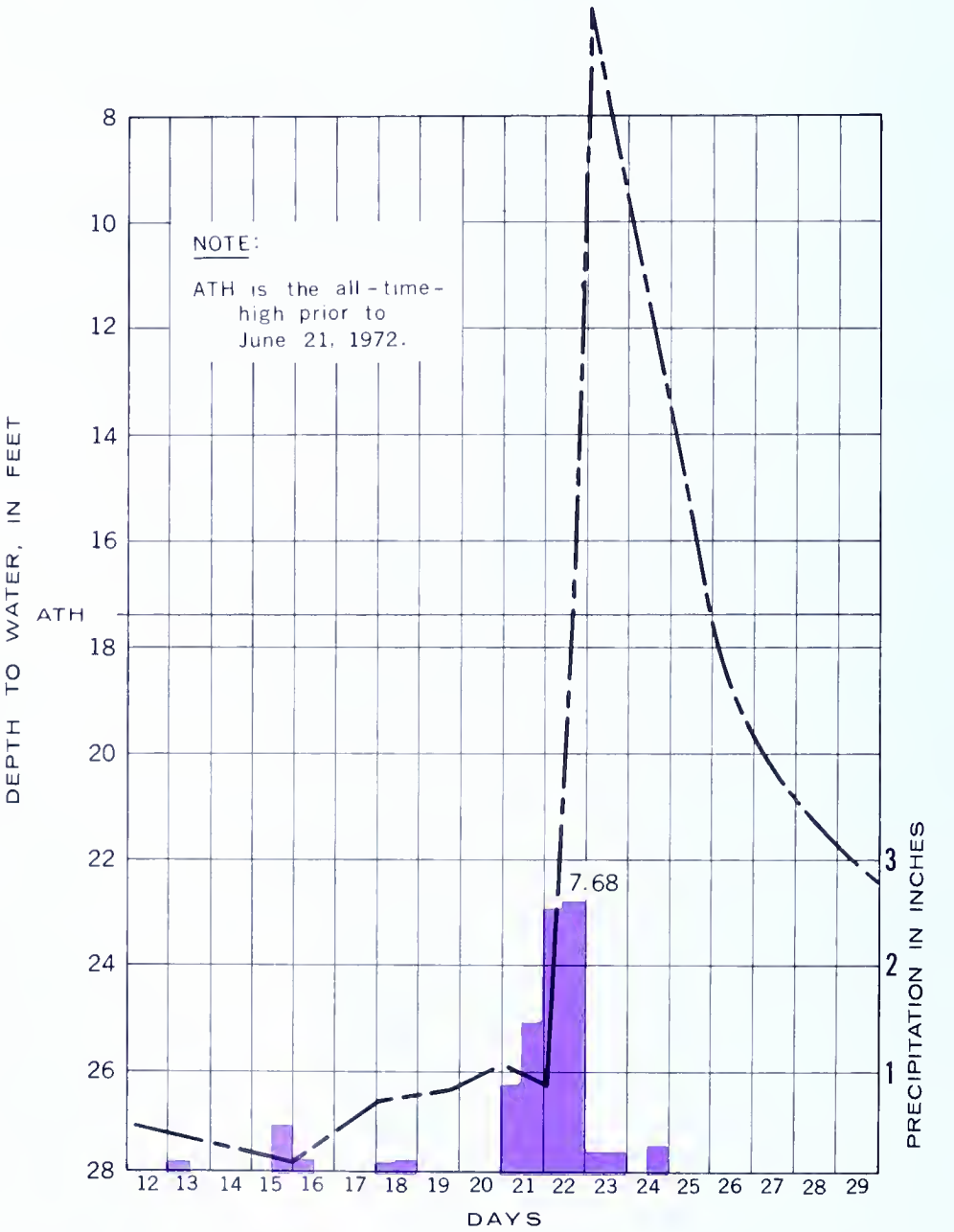


Figure 5. Water level hydrograph from well SU-34 and 12-hour precipitation totals at Canton, Pa. during June, 1972.

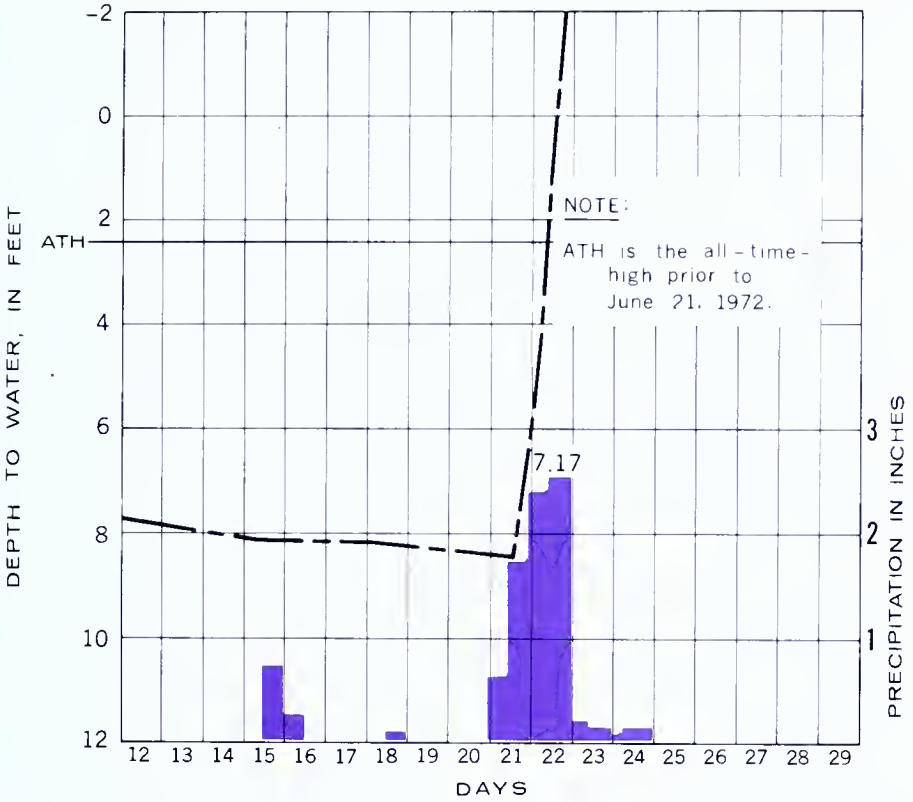


Figure 6. Water level hydrograph from well BR-92 and 12-hour precipitation totals at Towanda, Pa. during June. 1972.

A well located near the Susquehanna River, in Bradford County (Fig. 6) shows 7.2 inches of rainfall caused the water level to rise 10.3 feet to a peak about 2-feet above the land surface, which exceeded the previous all-time-high by 4.2 feet. Post "Agnes" record for this well was lost, because the recording device was a victim of the flood.

Although the occurrence of limestone in the basin is relatively minor, its weathering characteristics provided the fertile valleys and spring fed streams along which large population centers have developed. Chemical weathering of carbonate rocks by ground and surface water created a land surface that has low topographic relief, poor surface drainage, and numerous depressions. In many areas the water table fluctuates near the land surface (Fig. 2). As the result of "Agnes" the water table rose to above land surface in many areas, flooding many basements and forming lakes. Some lakes remained for several weeks after "Agnes" departed.

The hydrograph for the well located in the Wyoming Valley, Luzerne County (Fig. 7) shows the effect the high river level had on the ground-water level behind the river levee. The well is located 1000 feet behind the levee north of Forty Fort. Only 3.8 inches of rainfall was recorded at the Wilkes-

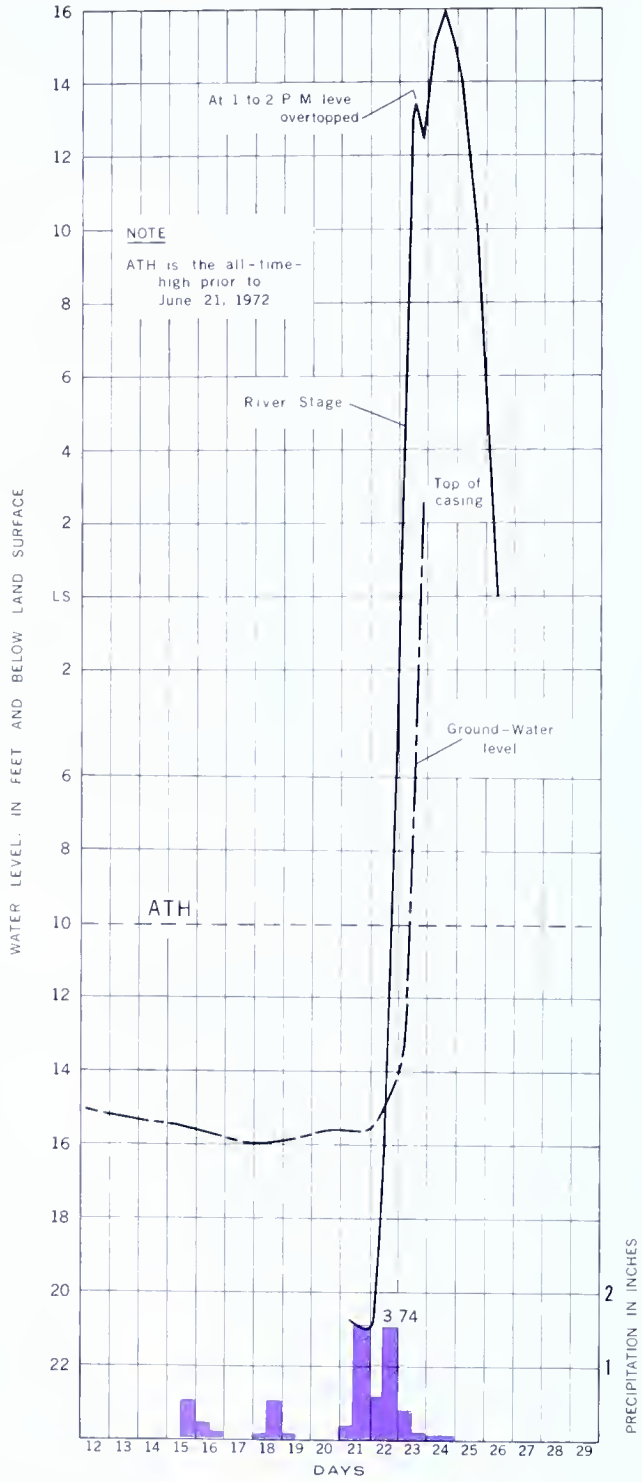


Figure 7. Water level hydrograph from well LU-309, Susquehanna River Stage and 12-hour precipitation totals at Wilkes-Barre-Scranton Airport for period June 12-26, 1972.

Barre-Scranton airport; however, the water level in the well rose to above land surface (Fig. 7). This was the combined result of the local precipitation and the recharge to the aquifer from the high river stage. The post "Agnes" record was lost under 7 feet of flood water; however, the water-level recorder was in operation long enough to show the ground water had risen above land surface prior to the failure of the levee at Forty Fort.

Had the levee not been overtopped and had it contained the river, much of the low-lying area behind the levee would have been flooded by ground water. The aquifer throughout much of the flood plain is a very coarse grained glacial outwash deposit, capable of transmitting water to wells at a rate of 2000 gpm. The area behind the dike could, using the present altitude of the levee system, receive over 60,000 gallons per minute of water from the river when the stage is near the top of the levee. Because of the high transmissivity of the near surface materials "sand boils" would have been common and possibly a threat to the stability of the levee.

Underground coal-mine pools in the Wyoming Valley attained record high levels also. Natural and man-made openings into the mines were spouting water. These overflows did not create a hazard, but the high mine pools did. Basements and back yards dropped into the mines in some 28 locations. At one location a 40-foot tree dropped out of sight. These so called "*potholes*" developed in areas where underground mining left little support for the unconsolidated gllacial drift overburden. The more serious potholing into mine voids occurred in the Parsons area, east of Wilkes-Barre. During the storm six potholes developed over the sub-surface contact of the coal beds and the glacial drift. The potholing was probably the combined result of saturation of the glacial drift by precipitation and increased hydraulic head imposed from below through rock fractures and mine openings by rapidly rising mine pool. The possibility of future potholing is being reduced by filling of mine voids through joint State and Federal efforts.

Ground water continued to plague some unfortunate home owners after the flooding was over. Heavy duty pumping equipment rushed into service, quickly emptied many of the basements only to remove the equalizing pressure within the basement against the ground water outside, which caused basement floors to blow up or walls to cave in. Basements were not damaged where the water was permitted to drain away, or was pumped out after ground-water levels returned to below basement elevations.

In comparison to the destruction by overland flooding, ground-water flooding destruction is relatively unseen. However, it is by no means minor. As a result of Agnes, the geologic and topographic settings subject to ground-water flooding were recognized and can be delineated. Future building codes and zoning of these areas should be accomplished.

J. R. Hollowell
Susquehanna River Basin Commission

1973 - A GOOD YEAR FOR THE MINERAL INDUSTRY OF PENNSYLVANIA

The value of mineral production in Pennsylvania in 1973 was $1.3 billion, 7.1 percent more than recorded for 1972, according to the U. S. Bureau of Mines. Mineral fuels accounted for 65 percent of the State's dollar value with nonmetals making up 32.4 percent and metals accounting for the remaining 2.6 percent. After coal, the most valuable minerals produced were cement, crushed stone, lime, sand and gravel, natural gas and petroleum.

Each of the non-metallic mineral commodities registered an increase in production over the previous year. With the closing of the iron mine at Cornwall in 1973, the iron mine at Morgantown and the zinc mine at Friedensville are the only two active metal mines in Pennsylvania.

The table below shows the production and value by mineral commodities for Pennsylvania in 1973:

1973 production in Pennsylvania
(As prepared by U.S. Bureau of Mines)

	1973	
	Quantity	Value (thousands)
Cement:		
Portland ... thousand short tons ...	8,640	$177,000
Masonry ... do ...	490	14,700
Clays ... do ...	2,950	18,902
Coal: Anthracite ... do ...	6,500	79,950
Bituminous ... do ...	75,020	731,450
Copper: (recoverable content of ores, etc.) ... ... short tons ...	1,395	1,660
Gem stones ...	NA	9
Lime ... thousand short tons ...	2,260	40,155
Natural gas ... million cubic feet ...	71,445	25,363
Peat ... thousand short tons ...	27	416
Petroleum (crude) ... thousand 42-gallon barrels ...	3,803	20,118
Sand and gravel ... thousand short tons ...	18,943	37,507
Stone ... do ...	72,755	139,168
Zinc (recoverable content of ores, etc.) ... ... short tons ...	18,590	7,458
Value of items that cannot be disclosed:		
Iron ore, scrap mica, tripoli, and natural gas liquids .	XX	25,149
Total ...	XX	1,319,005

PENNSYLVANIAN PALEOBOTANY OF THE BERNICE BASIN, SULLIVAN, WYOMING, AND LUZERNE COUNTIES, PENNA.

Examination of four hundred and thirty-nine (439) plant fossil specimens collected from the Bernice Coal Basin and surrounding areas of Sullivan, Wyoming, and Luzerne Counties, has resulted in the identification of approximately twenty-eight (28) genera and approximately eighty-nine (89) species. The location of the collecting sites are shown superimposed on the State Geologic Map (Gray and others, 1960) in Figure 1. Summary lists of the more important fossil plants are given in Table 1.

Comparison of the biostratigraphic suite represented by these plant forms to the floral zonation for Upper Paleozoic rocks of the central Appalachians (Reed and Mamay, 1964) gives a good overall correlation with zones 7, 8, 9, and 10. In particular, however, the most diagnostic forms of zones 7, 9, and 10 are not found, and only *Neuropteris tenuifolia*, the

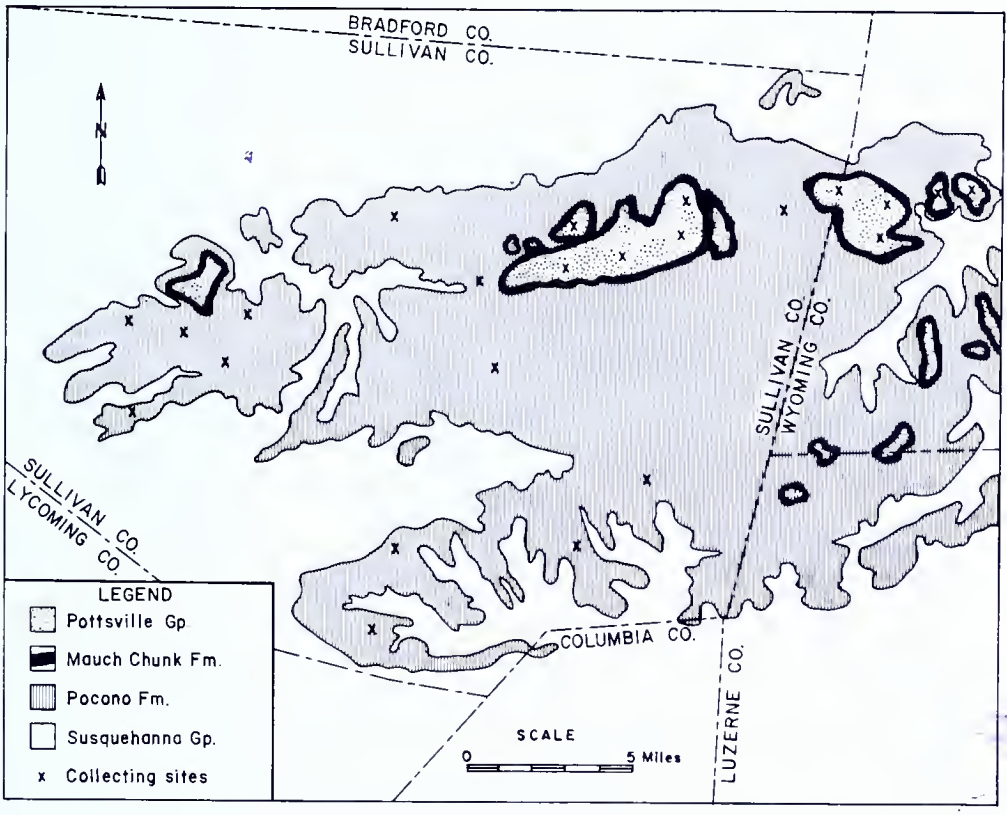


Figure 1. Fossil collecting sites and current geology of Sullivan and parts of Luzerne and Wyoming Counties. (after Gray and others, 1960)

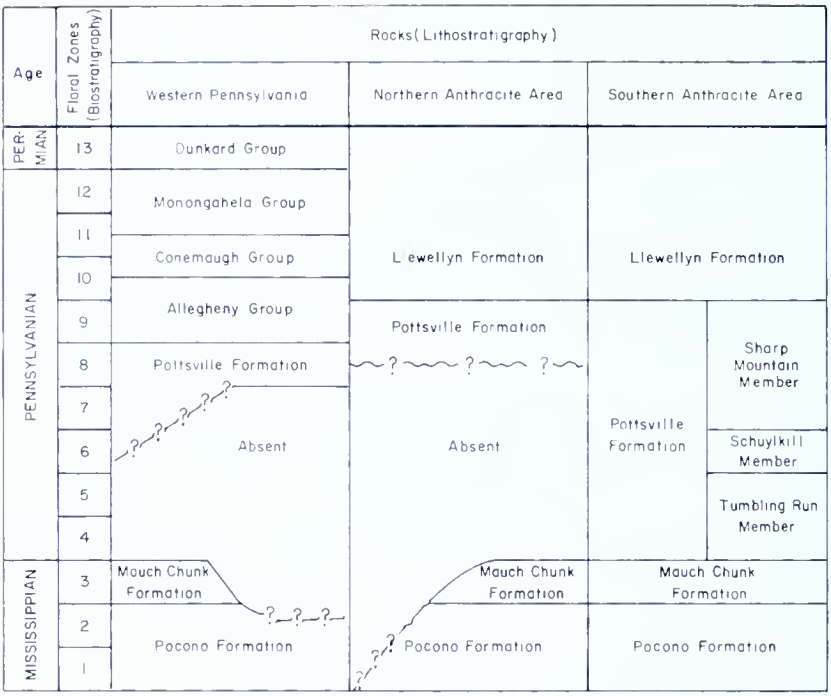


Figure 2. Presumed chronostratigraphic biostratigraphic and lithostratigraphic relationships of the Upper Paleozoic of Pennsylvania.

Table I. Genera and species of fossil plants collected in northeast Sullivan County.
The number in parentheses are the occurrences.

Alethopteris sp.	(8)	*Neuropteris capitata*	(2)
grandifolia	(7)	*gigantea*	(12)
serlii	(4)	*flexuosa*	(2)
Annularia ramosa	(2)	*ovata*	(14)
stelata	(5)	*ravineruis*	(16)
Astrophyllites sp.	(5)	*tenuifolia*	(21)
equeseformis	(3)	*schuechzeri*	(25)
minutus	(4)	*Pecopteris sp.*	(6)
Calamites sp.	(17)	*dentata*	(5)
ramosus	(11)	*miltoni*	(27)
suckowii	(28)	*Sigillaria sp.*	(9)
Calamocladus	(8)	*brardii*	(2)
Calamostachys ramosus	(7)	*Sphenophyllum furcatum*	(3)
Lepidodendron sp.	(20)	*emarginatum*	(2)
dichotomum	(5)	*Sphenopteris sp.*	(11)
obovatum	(3)	*mixta*	(5)
vestitum	(7)	*spinosa*	(9)
Lepidodendron "leaves"	(11)	*Trigonocarpum*	(5)
Lepidostrobus	(9)	*olivaeforma*	(1)
obovatum	(6)	*Trigonocarpus*	(21)
Mariopteris	(16)	*Trigonocarpus seeds*	(14)
nervosa	(3)	*Triphyllopteris spp.*	(3)
Megalopteris spp.	(1)	*Ulodendron*	(15)
		Total	388

diagnostic form of zone 8, is present. Most of the zone 7, 9, and 10 forms encountered are long-ranging types which also occur in zone 8. It appears, thus, that the fossil suite of this area is assignable most specifically to floral zone 8.

Customarily, floral zone 8 is considered to be Middle Pennsylvanian age and to be characteristic of the upper part of the Pottsville Group. The presumed chronostratigraphic, biostratigraphic, and lithostratigraphic relationships are summarized in Figure 2.

As shown on the State Geologic Map (Gray and others, 1960), the coal-bearing rocks of the Bernice Basin itself appear to be correctly identified as Pottsville Group (see Figure 1). However, outside the immediate Bernice Coal Basin, in areas currently shown as entirely Pocono Formation, many ridge tops are capped by rocks containing this same upper Pottsville flora. It appears, then, that extensive additional areas around the Bernice Basin should be shown as underlain by the Pottsville Group.

Deborah Birx

References:

Gray, C. and others (1960) *Geologic Map of Pennsylvania*, Pa. Geol. Survey, 4th series, map no. 1.

Reed, C. B. and Mamay, S. H. (1964) *Upper Paleozoic Floral Zones and Floral Provinces of the United States*, U. S. Geol. Survey, Prof. Pap. 454K.

ABOUT THE AUTHOR

Miss Birx is a 1973 graduate of Carlisle High School and is presently attending Houghton College. She was 1973 girls' grand champion in the Capital Area Science and Engineering Fair and took third place in the Earth and Space Science division at 1973 International Science and Engineering Fair at San Diego, California. She was also awarded an honorable mention from the American Association of Petroleum Geologists and first place awards from the U. S. Army and U. S. Navy. Needless to say, Miss Birx has been pursuing studies in this area for several years.

SURVEY ANNOUNCEMENTS

PHILIPSBURG QUADRANGLE REPORT ISSUED

The Pennsylvania Geological Survey has published *The Geology and Mineral Resources of the Philipsburg Quadrangle*, by Gary Glass. This comprehensive, 241-page report complete with full-color maps and plates, describes the nature and occurrences of the surface and subsurface rock units of a 56-square-mile area of western Centre County and eastern Clearfield County.

The locations, quality and quantity of coal and other mineral resources in the area are stressed. Six major coal seams occur in the area although two seams of minor importance, coupled with splits of the major seams and locally important rider coals, swell this number to fifteen. Coal is the most important resource at this time, with unmined reserves totaling a minimum of 122 million short tons in seams over 28 inches thick. Clay, shale, building stone, and limestone are other mineral resources of the area. A glossary is included to assist nontechnical readers.

This report should be of particular use to mineral industries, planners, highway and construction engineers, conservationists, and students of geology and natural history of Pennsylvania. The report provides the geologic information prerequisite to landuse planning and mineral resource development.

Bulletin A95a, "Geology and Mineral Resources of the Philipsburg Quadrangle" is available from the Pennsylvania Bureau of Publications, P. O. Box 1365, Harrisburg, Pennsylvania, 17125 for $10.10 plus State tax for Pennsylvania residents.

LEHIGH COUNTY WATER REPORT PUBLISHED

One of the most comprehensive water resources reports ever issued for any county has been released by the Pennsylvania Geological Survey as Bulletin W 31, "Water Resources of Lehigh County, Pennsylvania." The study was co-sponsored by the Pennsylvania Geological Survey, U. S. Geological Survey, and the Lehigh County Soil and Water Conservation District. This 263-page report, complete with full-colored maps and illustrations, was co-authored by Charles Wood, Herbert Flippo, Jr., Joseph Lescinsky, and James Barker of the U. S. Geological Survey.

The report presents the quantity and quality of Lehigh County surface and subsurface waters, the relationships between streamflow and groundwater, and watertable maps of the area underlain by carbonate rocks. Data on past and present water use is included, along with future projections.

This report will be valuable to planners and persons interested in land and water management. It will also aid industries, consulting engineers and geologists, and officials of local governments who are seeking new supplies of water or trying to find suitable sites for disposal of liquid and solid wastes. Sportsmen and conservationists will better understand how man's use has affected and will affect streamflow. Persons planning to drill wells for individual homes and businesses can use this report to estimate the probability of obtaining an adequate supply.

Bulletin W 32, *Water Resources of Lehigh County*, is available from the Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pennsylvania, 17125, for $9.15, plus State tax for Pennsylvania residents.

MORE SURPLUS TOPOGRAPHIC MAPS

After we announced a list of surplus topographic maps in the October, 1973, issue of this bulletin, we were quickly "cleaned out" by requests from near and far. Now again, as a result of our ongoing revision program, we have a stock of surplus 71/2-minute topographic quadrangle maps for over 400 different Pennsylvania quadrangles. We are again offering these at no charge, singly or in small quantities, to all interested parties. The list of quad names is too long to enumerate. It will be best if you simply indicate how many different quadrangles (and the number of copies of each) you desire from either northeast, southeast, north-central, south-central, northwest, or southwest Pennsylvania. We shall then try to send quad maps from the region indicated.

GEOLOGICAL SURVEY BEST SELLERS

For the past several years the Pennsylvania Geological Survey has been keeping records of the sale of our publications. For four of the past five years Bulletin G33, "Mineral Collecting in Pennsylvania," has been # 1 on the best seller list and Bulletin G40, Fossil Collecting is # 2.

Map # 1, the Geologic Map of Pennsylvania, has been the best seller of our map series for as long as we have kept records. The top ten list for 1973 includes the three Environmental Geology Reports issued to date (EG 1, 2, 3), the guides to the Geology of the Philadelphia and Pittsburgh areas (G 41, 59), Coal Reserves of Pennsylvania (IC 72), Oil and Gas Developments in 1971 (PR 184). Tied for 10th were the Bibliography to 1969 (G 61) and the Petroleum Industry and the future petroleum province in Pennsylvania (M 65).

SURVEY LIBRARY NEEDS

The Pennsylvania Geological Survey Library has need for the following items to help with its post-flood library rebuilding program. If anyone has any of these publications please contact State Geologist Arthur A. Socolow.

American Journal of Science: 1960, 1961, 1970, 1971
Clay Minerals: 1959 through 1964
Coal Age: 1971
Economic Geology: 1960, 1962, 1963
Geotimes: vol. 8 # 4 part 2 December 1963
vol. 8 # 5 part 1 January 1964
vol. 17 # 12 December 1972
Journal of Geology: 1904 through 1914, 1969, 1970, 1971
Micropaleontology: 1969 through 1971
Transactions AIME: 1969 through 1973
Transactions AGU: 1969 through 1971

U.S.G.S. Prof. Papers:	54	486 A	560 A
	189 C, H	502 B	563 A, B
	191	530	750
	254 F, C	541	
	402 C, D	549 A	
U.S.G.S. Bulletins:	89	954 A	
	127	995 I	
	301	1085 B	
	846 A		

STUDENT INTERN AT THE SURVEY

Joe Fox, a senior Earth and Space Science major at West Chester State College, joined the Survey staff in late January and will be with us for sixteen weeks. He is one of many Pennsylvania State College students participating in the Intern Program sponsored by the Department of Education.

Originally from Philadelphia, Joe is now a resident of Glenolden. He will finish his studies at West Chester this December and hopes to do graduate work in the field of geology education. Joe has participated in student government at West Chester and has served on various committees formulating academic policy during his junior year.

In addition to learning the basic operations and functions of the Survey, Joe will be engaged in several short-term research projects. These include an inventory of the ground water resources of the Upper Susquehanna River Basin as part of the State Water Plan, analysis of glacial sands and gravels in Pike and Monroe Counties, and organization and identification of specimens in our paleontological collection.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

Arthur A. Socolow, *State Geologist*
Donald M. Hoskins, *Assistant State Geologist*

TECHNICAL SERVICES

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Sandra Blust, *Librarian*
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Virginia Milewski, *Draftsman*
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TOPOGRAPHIC DIVISION

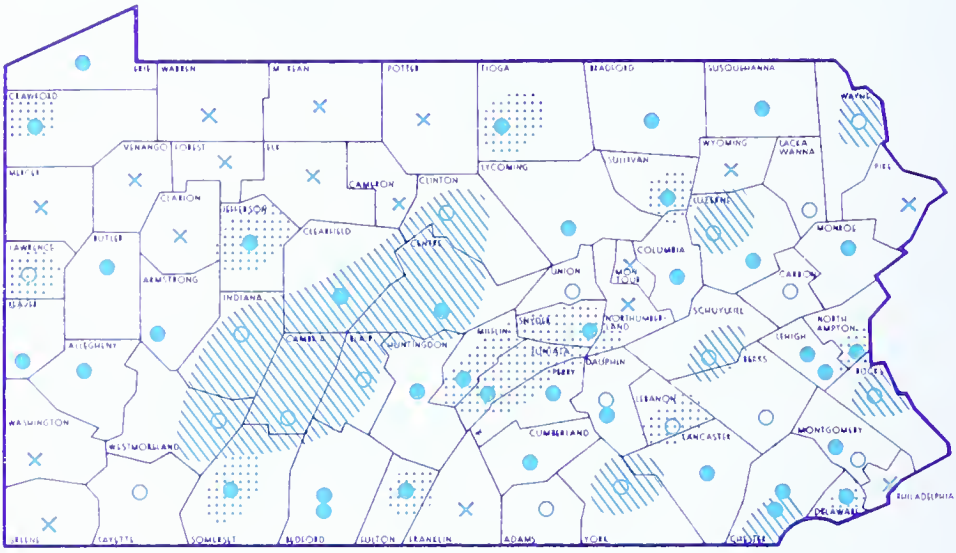
In Cooperation with The U.S. Geological Survey

GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

MARCH 1974

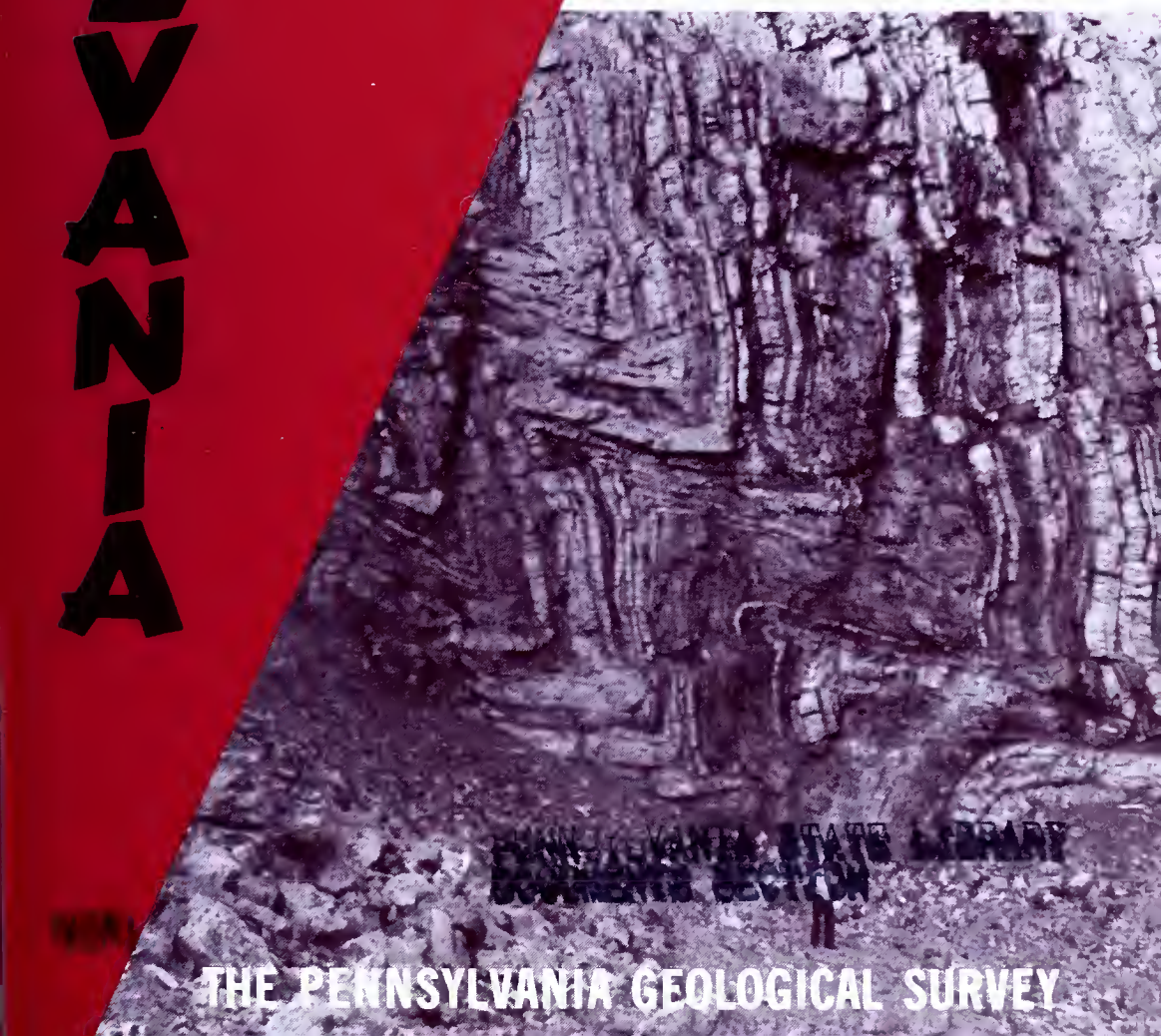
GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120

CORRECT ADDRESS REQUESTE

PENNSYLVANIA GEOLOGY



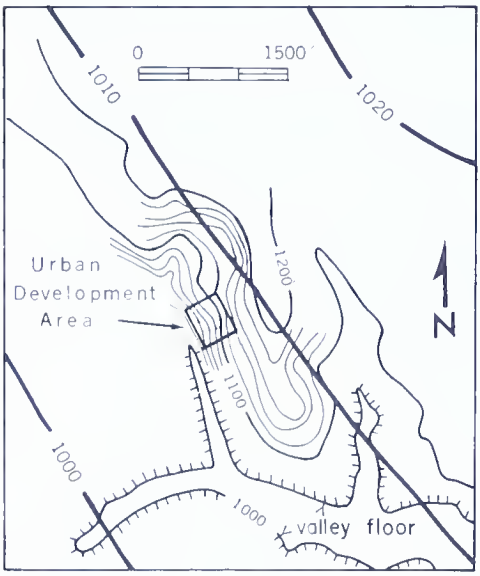
THE PENNSYLVANIA GEOLOGICAL SURVEY

IS A GEOLOGIC EVALUATION OF A DEVELOPMENT SITE NEEDED?

As an environmental geologist, I am frequently asked to explain what causes a home to crack or why there are long, large openings at the top of a particular hillside around Pittsburgh. In all cases reviewed, upon close investigation, geologic hazards existed and a problem could develop if proper planning and design procedures were not used when developing the site. In most cases, man had been modifying the surface on or near the site of the problem. In some of the cases, the geology of the site had indicated that no development should ever take place at that site.

Looking southeast from northwest end of slide area. Two houses occupied the empty rubble strewn area and were demolished two years ago. The cracks visible in the house started developing in December, 1973.

An excellent case in point started on February 12, 1974, when the Pittsburgh Press carried an article describing a landslide in Baldwin Borough in Allegheny County. A development consisting of ten single family homes was involved. Information as to the exact location of the housing development was obtained by phone from the Allegheny County Planning Department.



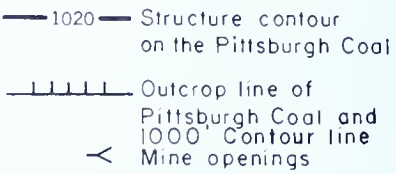


Figure 1.
Topographic and Geologic map of Urban Development

View of slide area looking northwest from southeast end of slide.

When the location of the housing development was plotted on a standard 7½' topographic map, the site was found to be about 100 feet above the valley floor at the top of a relatively steep east slope (see Fig. 1) and the distorted contour line configuration at the site and to the northwest along the slope indicated that there was some slope movement in this area in the past.

Where a house once was — note undercutting of concrete platform behind house.

Foundation and other rubble, all that remains of a house.

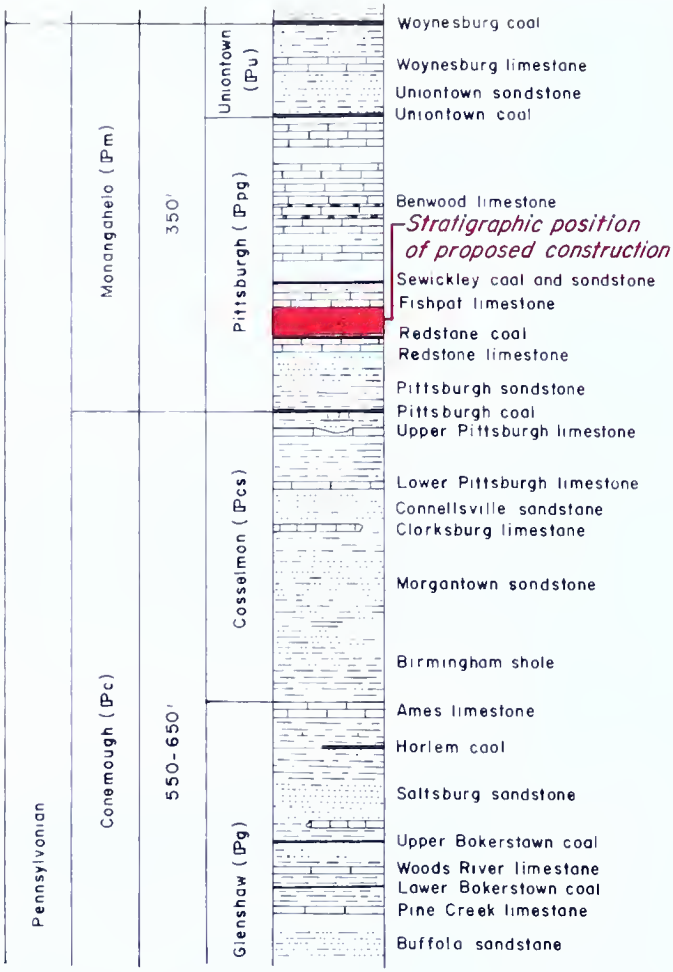


Figure 2.
Generalized stratigraphic section

The best determination of the stratigraphic position of the site placed it within the Redstone coal-limestone member and the Fishpot limestone of the Pittsburgh Formation (Fig.2). This portion of the stratigraphic section is composed of alternating layers of shale and claystone, with thin beds of fine sandstone. The rocks are dipping gently to the southwest (into an open valley) at about 40 feet to the mile. The Pittsburgh coal outcrops at an elevation of 1000 feet in the bottom of the valley (Fig. 1). Two deep mine openings are shown also on Figure 1.

These mines, although no longer active, can be assumed to extend beneath the hillside in question. Overburden thickness above the mined-out coal at the 1100-foot contour line therefore is approximately 100 feet maximum, decreasing down the slope.

One final comment that could be made is that groundwater should be encountered at the contact of the limestone and sandstone with the underlying impermeable shales and claystones. This groundwater will tend to flow towards the open valley due to the dip (inclination) of the rock layers.

Therefore, based on a simple, quick topographic and geologic evaluation of this site, the developer would know he must exercise extreme care in foundation design and in the placing of any fill. The mined out Pittsburgh-coal lies less than 100 feet below the site. The main potential problem on the hillside throughout the area would be mine subsidence.

The southwest facing slope has the potential of mine subsidence and slope instability. The rock layers dip very gently towards the open valley. Even though the inclination is slight, it establishes an inherent weakness in the rocks and even more important, water will migrate down this dip-slope. Land fill should be kept at a minimum; fill should be keyed into the hillside and where groundwater is encountered, drains should be installed to carry the water out of the fill. Storm runoff should be carried away from the site in a controlled storm-drain system. French drains in the fill material should be connected to the storm system to remove the water.

Obviously, the answer to our title is "YES".

Jesse L. Craft

WOMEN AND MINORITIES IN THE PHYSICAL SCIENCES

A recent manpower (person-power?) survey was conducted by the national Bureau of the Census, based on 100,000 scientists and engineers from the 1970 census. Some of the results are interesting, particularly those that apply to the physical sciences of which geology is a part. In general, there has been a 50% increase over 1962 in the total number of persons working in science and engineering.

Woman's role in physical science has increased, although the increase in mathematics is the most pronounced. For example, the number of female Ph.D. degree-holders has almost tripled in the physical sciences. Although the greatest number of workers are in the 25-49 year age bracket, considered to be most productive, women in the physical sciences generally are younger than men. Perhaps this reflects a recent influx of women into our profession. Also, women apparently do not proceed as far as men in the pursuit of the Ph.D. degree. The men greatly outnumber the women in Ph.D. status, but the number of women with a master's degree is much closer to the number of men. This ratio too should change with time.

Racial minorities, still rather scanty in geology, comprise only 17% of the people working in the physical sciences. Currently, the Geological Society of America is trying to increase the minority participation in geology.

According to a new release of the U. S. Geological Survey, the center of Pennsylvania is located in Centre County, two and a half miles southwest of Bellefonte.

MINERAL HERITAGE STAMPS

The annual Gem and Mineral show in Tucson, Arizona, is traditionally one of the largest and best attended in the United States. This winter thousands of mineral enthusiasts attending the 20th Annual Show were part of an historic event.

The United States Postal Service unvailed designs of four new stamps to be issued as a set commerating America's Mineral Heritage. The designs represent a new U. S. treatment of subject and in format. Never before has the Postal Service portrayed minerals. In addition, the mineral paintings are so arranged on the classic square stamp format that by rotating the stamps 45 degrees the designer achieved a diamond shape for the individual stamps as well as for the complete set of four stamps.

The stamps depict amethyst, rhodochrosite, tourmaline, and cut and polished petrified wood. All of these minerals have been found in Pennsylvania, although only amethyst and tourmaline are rather common (see Gordon, 1922; Montgomery, 1969; Lapham and Geyer, 1972). The stamps printed in eight inks (yellow, blue, brown, gray, green, purple and red) will be 1.075 x 1.075 inches in size with 48 stamps to a sheet.

The Mineral Heritage stamps will be issued June 13, 1974 at the National Gem and Mineral Show in Lincoln, Nebraska. First day ceremonies will be at the State Fair Grounds with the Lincoln Gem and Mineral Club as hosts.

These Mineral Heritage stamps will call attention to the great contribution minerals have made to mankind. Many people are beginning to appreciate this nation's mineral heritage. We must evaluate the relative importance of wealth, employment, physical comfort, and a declining mineral abundance. Today, more than at any time since colonial days, we realize that our mineral resources are not infinite and must be used wisely. The mineral industries, the professional mineralogists and the growing ranks of mineral hobbiests are all contributing a positive force in this direction.

Alan R. Geyer
Davis M. Lapham

References:

Gordon, Samuel G (1922), *The Mineralogy of Pennsylvania*; Spec. Pub. No. 1, The Acad. Nat. Sci. of Philadelphia, 255 pp.

Lapham, D. M. and Geyer, A. R. (1972), *Mineral Collecting in Pennsylvania*; Pa. Geol. Survey Bull. G-33, 164 pp.

Montgomery, Arthur (1969), *The Mineralogy of Pennsylvania: 1922-1965*; Spec. Pub. No. 9, The Acad. of Nat. Sci. of Philadelphia, 104 pp.

GEOLOGY OF PENNSYLVANIA SUPPORTS MAR'S THEORY

Dr. Dean McLaughlin, an astronomer turned geologist, who for many years before his passing mapped the Triassic rocks of southern Pennsylvania for the Pennsylvania Survey, is the focus of an article in the January-February issue of American Scientist, the magazine of Sigma Xi, the Scientific Research Society of North America, Inc.

His combined work as geologist in Pennsylvania and astronomer at the University of Michigan led him to formulate a theory for markings on the planet Mars, as seen through telescopes, suggested a volcanic and aeolian (wind) origin. The Mariner 9 photographs have, in large part, provided support for his theory, one of the few that have stood the test of time and addition of evidence. Mariner 9 photos show that aeolian transport is one of the dominant causes of albedo markings as McLaughlin suggested. The photos also show that McLaughlin's theoretical wind patterns are reasonably correct. McLaughlin's suggestion that volcanic materials would be found on Mars is also correct.

For anyone who wishes to read the article, it is "McLaughlin and Mars" by J. Veverka and C. Sagan, pages 44-53, American Scientist, vo. 62, no. 1.

INTERESTING MINERALS FROM PENNSYLVANIA'S ZINC-LEAD OCCURRENCES

While examining sphalerite and galena occurrences in Pennsylvania, an attempt is being made to note all accessory minerals. Accessory minerals can often furnish valuable clues to ore genesis, economic byproducts, and "pathfinder" elements useful in geochemical exploration. Arsenic is one element which has recently been recognized in various mineral forms at several zinc-lead occurrences in Pennsylvania. The greatest concentration to date was found in a previously unreported, but substantial limonite — quartzite gossan from Bald Eagle Mountain, Centre County. A representative sample of the many tons of float lying about contained 0.5% arsenic as well as 0.6% lead and 0.1% copper.

Listed below are some accessory minerals recently identified with a brief discussion of each. The author's visual identifications have been verified by X-ray diffraction by John Barnes and Les Chubb. For the minerals acanthite, apatite, mimetite, and native sulfur the first identifications were by X-ray diffraction by John Barnes. Credit is also due to the staff of the X-ray laboratory of PennDOT's Bureau of Materials, Testing and Research. They have graciously allowed the Survey to use their facilities for the prolonged period following the Agnes Flood during which the Survey has been in temporary headquarters without a laboratory.

Acanthite, Ag_2S (silver sulfide), the low temperature dimorph of argentite, was found as a single black grain with tetrahedrite in quartz from the Billmeyer quarry, Lancaster County. Freedman (1972) reported that argentite (probably acanthite because the old X-ray data for argentite was actually from an acanthite specimen) could be detected by X-ray diffraction of sphalerite from the Bamford mine, also in Lancaster County.

Albite variety cleavelandite, $NaAlSi_3O_8$ (sodium aluminosilicate), occurs with galena in quartz veins in the Pequea and Burnt Mills silver mines, Lancaster County. A few galena crystals from Burnt Mills contain sphene crystals, whereas rutile, another titanium mineral, is common at the Pequea mine.

Descloizite - mottramite, $PbZn(VO_4)(OH)$ - $Pb(Cu,Zn)(VO_4)(OH)$ (lead zinc vanadate hydroxide-lead copper zinc vanadate hydroxide), was verified in a sample with tiny brown crystals furnished by Joseph Varady of Spring City. It was found in a dump from the Chester County mine, Phoenixville district, Chester County. From X-ray data, Barnes believes that this specimen is not close to either end member of this solid solution series. Professor Raymond Grant of Lafayette College (personal communication, 1974) has arrived at the same conclusion for another sample from the same district.

Enargite, Cu_3AsS_4 (copper arsenic sulfide), first identified by its striated, prismatic crystal habit, occurs with sphalerite and galena in calcite

at Lime Bluff, Lycoming County. A few pseudomorphs of lime-green cornubite, $Cu_5(AsO_4)_2(OH)_4$ (copper arsenate hydroxide), after enargite were observed, and a few millimeters father from the eneragite, bluish-green conichalcite, $CaCu(AsO_4)(OH)$ (calcium copper arsenate hydroxide), has been found on calcite. This location, previously unknown to us, was kindly brought to our attention by Tom O'Neil of Montoursville.

Jordanite, $(Pb, Tl)_{13}As_7S_{23}$ (lead thallium arsenic sulfide), occurs as late, metallic, gray rims on galena associated with sphalerite in limestone breccia. It was collected underground at the Keystone mine, Blair County, with assistance from John H. Way and Professor Arthur W. Rose of Penn State.

Mimetite - pyromorphite, $Pb_5(AsO_4)_3Cl$ - $Pb_5(PO_4)_3Cl$ (lead arsenate chloride - lead phosphate chloride), was found as acicular white crystals with hemimorphite underground at the Doughty mine, Northumberland County. Pale blue smithsonite has been collected from a different part of the same mine.

Native Sulfur, S, is common as thin, pale yellow coatings on sphalerite associated with galena and barite on the dumps of an old adit at Milesburg Gap, Centre County.

Posnjakite, $Cu_4(SO_4)(OH)_6 \cdot H_2O(?)$, and langite, $Cu_4(SO_4)(OH)_6\ 2H_2O(?)$, both copper sulfate hydroxide hydrates), were found by Martin L. Anne of Wrightsville as microscopic, dark blue crystals with other secondary minerals on a sample from the Ecton mine dumps, Montgomery County (Barnes, 1973). The author noted hydrous copper sulfates on the sample, sent for identification of a more abundant copper mineral. The sample was donated by Mr. Anne to the William Penn Memorial Museum.

Pseudomalchite, $Cu_5(PO_4)_2(OH)_4 \cdot H_2O$ (copper phosphate hydroxide hydrate), was found by Gloria J. Smith, the author's wife, as mamillary green crusts with a slight bluish tint on quartz from the Whim shaft dumps, Montgomery County.

Tennantite, $(Cu, Fe)_{12}As_4S_{13}$ (copper iron arsenic sulfide) occurs as small, metallic gray grains associated with galena, chalcopyrite, and pyrite in the Hares Valley area, Mapleton, Huntingdon County. Similar occurrences elsewhere in the Hares Valley area have yielded muscovite, probably $2M_1$, on quartz crystals and apatite in fluorescent orange sphalerite.

References

Barnes, J. H. (1973) Three new minerals for Pa., *Pennsylvania Geology,* v. 4, no. 4, p. 30-31.

Freedman, Jacob (1972) Geochemical prospecting for zinc, lead, copper, and silver, Lancaster Valley, Southeastern Pennsylvania, U. S. Geological Survey Bull. 1314-C.

Robert C. Smith, II

SINKHOLES AT HERSHEY

Newly developed sinkholes continue to appear in many areas. These two recently appeared over The Epler Formation. The Hershey Medical Center is in the background. Photo taken in March, 1974 by W. H. Bolles, Pennsylvania Department of Education.

PA. MINERAL TRAVELS TO FRANCE

Recently the Pennsylvania Geological Survey received a request from Dr. C. Guillamin at the Ecole des Mines de Paris where the national mineral collection of France is kept. They requested philadelphite, chrome-antigorite, lansfordite, and colerainite from Pennsylvania to complete their systematic collection. Not only were we able to supply information and locations for these minerals. partly from our files and partly from our Bulletin G-33, Mineral Collecting in Pennsylvania, but we also were able to supply them with a specimen of colerainite from Nottingham, Chester County donated to us in 1960 by Francis Kunkle. We were glad to be of assistance to such a famous museum, but perhaps more important, this is an excellent example of one function of the Survey and of the generous help of many amateur collectors throughout the Commonwealth.

D. M. Lapham

URANIUM IN THE HARDYSTON FORMATION

During a study of some rare minerals in the gneisses of the Durham-Reading Hills of Lehigh and Northampton Counties, the following observations of the Hardyston Formation were made. These observations, presented in chronological order, suggest that a modern, instrumental study of the uranium content of the Hardyston should be undertaken.

In 1956 it was noted that the base of the lower Cambrian Hardyston Formation, composed of conglomeratic, medium-grained sandstone, was slightly radioactive at an exposure in an abandoned building-stone quarry along River Road, one mile west of the Hill to Hill Bridge, Bethlehem, Pa. The radioactivity was detected just above a pinite (a rock which resembles serpentine, but is actually composed of fine-grained muscovite and strained quartz) layer described by Miller (1941, p. 460). The pinite layer, which contains euhedral zircon crystals, is the sheared contact rock between the base of Cambrian conglomerate and the top of Precambrian granitic gneiss.

Later, in 1965, the author searched for allanite (rare earth-bearing epidote) localities in the gneisses of the Durham-Reading Hills where the Hardyston also occurs. A Bethlehem Steel Company employee noted radioactivity at a possible locality at Camp Mizpah on Dutch Hill (Allentown East 7½' topographic map), 1.8 miles west of the pinite locality mentioned above. No allanite was found here, but one piece of Hardyston float found in the woods south of Camp Mizpah weighed about 100 lbs. and the radioactivity on contact was about twenty times that of background. The heavy accessory minerals in this sample were studied at Lafayette College by means of X-ray diffraction. Most of the radiation was attributable to an orange-brown, translucent mineral visible in hand specimen. Thirteen d spacings were obtained by X-ray diffraction: 4.75 A (very strong), 3.60 A (v.s.), 2.86 (medium), 2.68 (strong), 2.23 (weak), 2.02 (w), 1.98 (w), 1.84 (m), 1.60 (w), 1.50 (w), 1.43 (w), 1.36 (w), and 1.28 (w). Ten of the d spacings were consistent with those uranothorite, ten with those of synthetic thorite, and no spacings remained unidentified. Rutile and brookite were also identified by X-ray diffraction, whereas quartz, microcline, and zircon were identified in thin section. No allanite was found in these samples and further study of the occurrence was dropped at that time.

However, in 1967 a representative sample of the same 100 lb. block was assayed for gold and silver in the belief that heavy metals might be present. Only the slightest trace of Ag was detected. Professor Arthur W. Rose at Penn State kindly analyzed the same sample pulp by emission spectrography and found that Ti and Zr were "high"; La, Y, and Yb were "intermediate"; and Ag, Be, Ga, Mo, and U were "low but detectable" by visual estimates. By quantitative emission spectrographic procedures, Professor Rose found 50 ppm (parts per million) Zn, 35 ppm Cu, 160 ppm

Ni, 15? ppm Co, 42 ppm Cr, 430 ppm V, 210 Mn, 8 ppm Pb, 6.7% Fe, a trace of Ag, and uranium not determined. Except for slightly high Ni and V, however, none of these quantitative determinations are anomalously high.

Aaron (1969, p. 25) reported that "Monazite, an unusually common *accessory* (present author's italics) in the Hardyston, is second in abundance only to magnetite and limonite." In each of the three Hardyston arkose and arkosic sandstone samples from the Nazareth 7½' quadrangle (the next quadrangle to the northeast) examined by Aaron, monazite (a rare earth and thorium phosphate) was found to be a common accessory mineral. Aaron's mineral identifications were by thin section only (John M. Aaron, personal communication, 1974) and conceivably the mineral identified as "monazite" by Aaron could instead be a uranium-bearing mineral. If so, there may be detrital uranium over a significant area.

Using a resolving gamma ray spectrometer, spectra obtained for whole rock samples from the original 100 lb. Hardyston block from Camp Mizpah show anomalous intensity in the 1.6 to 2.5 MeV (uranium) range but only background in the 2.5 to 3.1 MeV (thorium) region. Comparison with spectra obtained from samples with known thorium (Th) and uranium (U) contents showed that the lack of Th counts was not just a function of the normally lower intensity of the Th peak (with respect to the peak from an equal amount of uranium) nor a poorer detection efficiency for the higher energy Th gamma rays. Commercial analyses show that the original sample contained about 1 ppm Ag, 500 ppm La, 10 ppm Mo, 100 ppm Nb, 200 ppm Ni, 7 ppm W, 300 ppm Y, 1000 ppm Zr, and 380 ppm U_3O_8. At present, 0.1% (1000 ppm) U_3O_8 is about the minimum ore grade for uranium. If uranium follows the trend of many other metals, this grade will decrease in the future.

Although the author's thin sections were destroyed in the Agnes Flood of 1972, chips saved elsewhere suggest that the original sample was a medium-grained (0.25 to 0.5 mm) sandstone composed of about 80% quartz, 10% feldspar, and 10% non-magnetic Fe-Ti oxides plus heavy minerals (visual estimates). Although rock of such composition would be expensive to grind because of its hardness, grinding and physical removal of quartz and feldspar would yield a product containing about 0.15% U_3O_8, 0.2% La, 0.1% Y, 0.4% Zr, and perhaps significant Ti. Further separation of Fe-Ti oxides could possibly double the above concentrations prior to recourse to chemical separation.

Over a dozen occurrences of rare earth, Th, and U minerals were observed in the Precambrian rocks of Lehigh and Northampton counties during the few days of field work for the allanite study. It thus seems likely, as Aaron (1969) concluded, that the rare elements of detrital origin in the Hardyston Formation have originated from the Reading Prong itself.

The constructive comments of John M. Aaron are gratefully acknowledged.

Robert C. Smith, II

NEW OPEN FILE MAPS OF CARBON, NORTHAMPTON AND MONROE COUNTIES

The Pennsylvania Geological Survey is placing an open file bedrock and surficial geologic maps of the following 7-1/2 minute quadrangles:

Christmans and Pohopoco Mountain quads, Carbon County, Pa.
Hickory Run and Blakeslee quads, Carbon and Monroe Counties, Pa.
Tobyhanna and Buck Hill Falls quads, Monroe County, Pa.
Lehighton and Palmerton quads, Carbon and Northampton Counties, Pa.

Final publication will occur in late 1974. These maps may now be examined in the Survey office, Towne House Apartments, 660 Boas Street, Harrisburg.

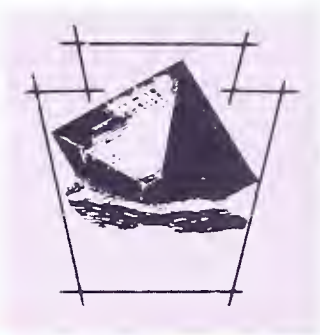
PENNSYLVANIA ENVIRONMENTAL CONFERENCE

Over 325 delegates met in Harrisburg on February 20 and 21 to attend the fourth annual Pennsylvania Environmental Conference and discuss "Creative Land Management for Pennsylvania." Sponsored by the Pennsylvania Environmental Council, the conference brought together environmentalists, planners, representatives of industry, labor and agriculture, government administrators, students and educators.

Delegates participated in 12 task forces, each aimed at developing a different aspect of a land use policy for the Commonwealth. Reports of each task force, along with over-all recommendations of the Conference, will be forwarded to the Office of State Planning and Development for use in helping to develop an effective land use policy for Pennsylvania. Recommendations stemming from the Conference will also be sent to the Governor, the Legislature, conservation groups across the State and to all Conference attendees.

Russell W. Peterson, Chairman of the President's Council on Environmental Quality, and former Governor of Delaware, was the highlight speaker at the Conference Banquet. Mr. Peterson spoke on Land Use and the Quality of Life, stressing the need for a de-emphasis on growth. He called land "our most irreplaceable resource" and ended his address with a "Declaration of Interdependence," emphasizing the need to work together and in harmony with our environment to enhance the quality of life everywhere. This outstanding declaration is presented here in its entirety:

> "We the people of planet Earth with respect for the dignity of each human life, with concern for future generations, with growing appreciation of our relation to our environment, with recognition of limits to our resources and with need for adequate food, air, water, shelter, health, protection, justice, and self-fulfillment, hereby declare our interdependence and resolve to work together in brotherhood and in harmony with our environment to enhance the quality of life everywhere."



EARTH SCIENCE TEACHERS' CORNER

new leaflets from the U.S.G.S.

"OIL SHALE—A POTENTIAL SOURCE OF ENERGY", 15 pages

When the nation's supply of conventional fuels dwindles, oil shale constitutes an immense source of energy; this pamphlet explains what oil shale is, its history, where it is found and products and uses.

"MAP, LINE AND SINKER", 6 pages

Are you a fisherman? Do you need help in determining bottom conditions of man-made water bodies in order to catch the "big ones"?

"PERMAFROST", 15 pages

A brief description of permafrost; environmental problems involved when human activities come in contact with permafrost; of particular interest since the Alaska pipeline must cross vast areas of permafrost.

"THE EROS DATA CENTER", 19 pages

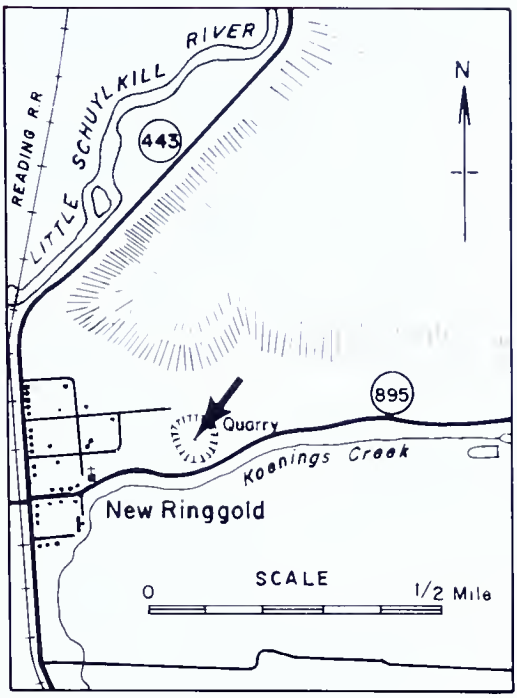
A description of this new U.S.G.S. data center, its location, its files, and its operation.

"NUCLEAR ENERGY RESOURCES—A GEOLOGIC PERSPECTIVE , 15 pages

Geological knowledge has been the most important factor in discovering uranium; this pamphlet explains the nuclear energy fuel, the occurrence of uranium and thorium, how nuclear resources are found and exploited and the potential reserves of uranium and thorium.

These pamphlets are available free of charge from the U.S. Geological Survey, Distribution Section, 1200 South Eads Street, Arlington, Virginia, 22202.

A NEW FOSSIL COLLECTING LOCALITY



A new collecting locality in Schuylkill County for Devonian Period marine fossils was recently reported to the Pennsylvania Geological Survey by Mrs. Bernice Meredith, a resident of Tamaqua. We examined the locality for its suitability for amateur collectors and can report that it is a safe location with relatively abundant fossils and it is easily accessible. The locality is in a borrow pit used by local authorities for road fill and is on the north side of Pennsylvania Route 895, 1,500 feet east of the intersection of Pennsylvania Routes 443 and 895 in New Ringgold, Schuylkill County. The borrow pit is large, extending about 100 yards to the north and 200 yards east and west. Ample space is available at the opening for parking well off the highway. There are no steep walls so it is easy to visit all parts of the quarry.

The rock exposed in the borrow pit is the Middle Devonian Mahantango Formation, approximately 370 million years old. The rock is largely silty claystone which is easily broken and weathers to small fragments. Small, subrounded nodules of siderite, an iron mineral, are also present; they have the shape of hickory nuts.

We have identified the following fossils from this locality:

Pelecypods
- Paleoneilo
- Actinopteria
- Cypricardinia

Miscellaneous
- Trilobite fragments
- Crinoid columnals

Brachiopods
- Devonochonetes
- Mucrospirifer
- Protoleptostrophia
- Tropidoleptus

Sketches or photographs of these fossils may be found in Bulletin G40, *Fossil Collecting in Pennsylvania*, or G48, *Stratigraphy of the Mahantango Formation*, of the Pennsylvania Geological Survey. These may be obtained by sending $.50 or $2.40 respectively to: Department of Property and Supplies, Bureau of Publications, P.O. Box 1365, Harrisburg, Pennsylvania 17125.

The fossils are represented largely by molds and casts, the original shell material having been dissolved. Some specimens however retain some of the original material and stand out as white against the dark rock. Many of the specimens are distorted from their original shape due to internal movement in the rock during the folding of the rock layers to their present, nearly vertical, position.

Should you visit this locality to collect, remember that you are on someone's private property and permission should be obtained if you can do so. CAUTION: This locality is occasionally used by local residents for target practice.

U.S. GEOLOGICAL SURVEY ISSUES NEW MAPS

The U. S. Geological Survey recently published five geological maps covering parts of Pennsylvania. These maps are 7½ minute quandrangle with all text and illustrations on the map sheet.

GQ 1047 —Stroudsburg Quadrangle, Northampton and Monroe Counties, Pennsylvania and Warren County, New Jersey

GQ 1054 —Delano Quandrangle, Schuylkill County

GQ 1067 —Midway Quandrangle, Washington County

I 1734 —Shamokin and Trevorton Quandrangles, Northumberland and Columbia Counties

I 1743 —Masontown and Morgantown North Quadrangles, Greene County

Each of these maps is available for $1.00 by writing to:

U. S. Geological Survey
1200 S. Eads Street
Arlington, Va. 22202

PENNSYLVANIAN HEADS U.S. BUREAU OF MINES

We are pleased to extend our greeting to Dr. Thomas V. Falkie who has been appointed as the new Director of the U. S. Bureau of Mines. Dr. Falkie has been Professor of Mining Engineering and Head of the Department of Mineral Engineering at the Pennsylvania State University. He succeeds Dr. E. F. Osborn, another former Penn Stater who has left the Bureau of Mines to accept the position of Distinguished Professor at the Carnegie Institution of Washington.

We are pleased to see that the federal agency which is responsible for helping to solve some of the critical energy and mineral problems continues to be under the leadership of an outstanding Pennsylvanian.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

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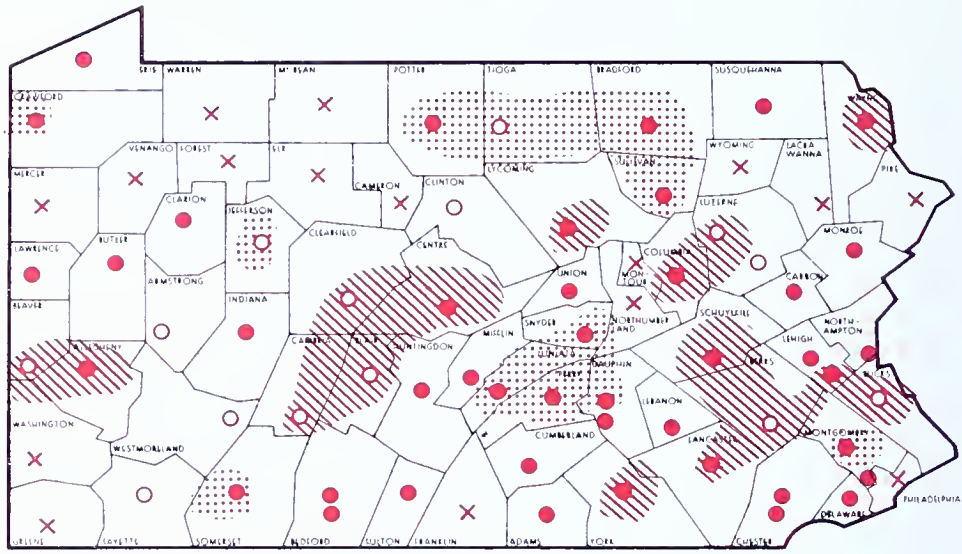
In Cooperation with The U.S. Geological Survey

GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

MAY 1974

GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120

CORRECT ADDRESS REQUESTE

PENNSYLVANIA GEOLOGY

THE PENNSYLVANIA GEOLOGICAL SURVEY

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Pennsylvania's idyllic landscape of farmland, mountains and forests, as seen along the Susquehanna River near Tunkhannock. Photo courtesy of Grant Heilman, Lititz, Pa.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

AUGUST 1974

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

GEOLOGY GOES UNDERGROUND

In recent years we have been pleased to note that geology is playing an ever-increasing role in our society at the national, state, and local levels. Geology is now involved in such diverse functions as land use planning, floodplain management, designation of wilderness areas, planning of mass transit routes, solid and liquid waste disposal site evaluation, area economic development, design of public water and sewage systems, and prevention of hazards such as landslides and subsidence.

Recently, as a member of the National Academy of Science's Committee on Tunnelling Technology, I was impressed with the stated need for geologic mapping and data as spelled out by engineers on the Committee, as well as administrators of the National Academy. The plea of the engineers was for the geologic community to step up the pace of geologic mapping in urban areas, with particular emphasis on subsurface geologic data in a language and format usable by engineers and designers. There is need for specific local data on rock properties and rock structures as they affect excavation and construction. The use of underground excavations for transportation, storage, mining, industry, and power generation is greatly increasing, particularly in the crowded urban and suburban areas. A new factor which is accelerating underground excavation is the recognition that underground placement of facilities alleviates undesirable environmental impacts of surface installations. Thus, the economics of subsurface installation is changing with the recognition that excavation costs are balanced by avoiding project delays and the high costs of surface environmental safeguards.

The engineering community engaged in subsurface excavation and installations points out that geologic mapping programs and subsurface investigations need to focus on the metropolitan areas where much of the excavation work is now concentrated and where more is likely to be undertaken in view of the stress on mass transit systems and improved water and sewage systems. The engineers urge geologists to provide detailed data on the subsurface rock structures and rock properties with which engineers must deal in their project work.

(continued on page 30)

GEOLOGICAL RESEARCH IN PENNSYLVANIA 1974

INTRODUCTION

This publication is the seventeenth annual report on Geological Research and Publications in Pennsylvania. Because of the extensive response and large number of projects reported to us, we have had to exercise editorial authority and reduce the description of the research in progress to fit our available space. In addition, we have attempted to determine an anticipated completion date (ACD) for each project.

The listings are grouped into major categories of research to facilitate your search for information on a particular subject. Publications in press are listed by author.

As with all compilations, there are omissions. This in unintentional. Additional copies of this report can be obtained by writing to the Bureau of Topographic and Geologic Survey, Department of Environmental Resources, Harrisburg, Pennsylvania 17120.

RESEARCH IN PROGRESS

AREAL GEOLOGY

H. H. ARNDT, U.S. Geol. Survey. Western Middle Anthracite Field. ACD: 1974.

T. M. BERG and W. D. SEVON, Pa. Geol. Survey. Geology and Mineral Resources of the Skytop 7½′ Quad., Monroe and Pike Cos., Pa. Field work is completed and office compilation is underway.

T. M. BERG and W. D. SEVON, Pa. Geol. Survey, and MILENA BUCEK, the Pa. State Univ. Geology and Mineral Resources of the Pocono Pines and Mt. Pocono 7½′ Quads., Monroe Co., Pa. Field work is completed and the bedrock geologic map is finished. A surficial geology map is nearing completion.

A. A. DRAKE, JR., U.S. Geol. Survey. Allentown Quad. and Vicinity [eastern Pa.]. Objectives: To decipher the tectonic history of the area with special emphasis on the emplacement of gravity slides, Alpine nappes, and thrust sheets as well as the mechanics of multiple deformation. Field work is complete in the Hellertown, Allentown East and Catasauqua quads. and has been started in the Cementon, Slatedale, New Tripoli, and Topton quads. ACD: 1980.

W. E. EDMUNDS, J. D. INNERS, and M. A. SHOLES, Pa. Geol. Survey, G. B. GLASS, Wyoming Geol. Survey, V. C. SHEPPS and G. A. ASHLEY. Geology and Mineral Resources of the Southern Half of the Houtzdale 15′ Quad., Clearfield Co., Pa. ACD: 1974.

J. B. EPSTEIN, U.S. Geol. Survey, W. D. SEVON, Pa. Geol. Survey, J. D. GLAESER, The City Coll. of the City Univ. of N.Y., and G. G. CONNALLY, SUNY at Buffalo. Wind Gap Area, Pa. Mapping of Lehighton and Palmerton quads. completed and in press. Wind Gap, Kunkletown, and Saylorsburg quads. being prepared for publication. Report on cleavage in eastern Pa. in preparation. ACD: 1974.

R. T. FAILL, Pa. Geol. Survey. Geology and Mineral Resources of the Montoursville South and Muncy 7½′ Quads., Lycoming Co., Pa. ACD: 1974.

G. W. FISHER, M. W. HIGGINS, and I. ZIETZ, U.S. Geol. Survey, Geologic Interpretation of Aeromagnetic Map of the Northern Piedmont [Va., Md., Pa., Del., N.J.]. ACD: 1975.

A. D. GLOVER, Pa. Geol. Survey, and W. A. BRAGONIER, R & P Coal Co. Geology and Mineral Resources of the Dubois 15′ Quad. Field work is completed and report is in preparation.

A. D. GLOVER and J. H. WAY, JR., Pa. Geol. Survey. Geology and Mineral Resources of the Altoona 15' Quad.

S. H. HOLLIS, Bryn Mawr Coll. Geology of the Bunker Hill Volcanics and Associated Rocks in the Martinsburg Shale. The southern half of the Fredericksburg 7½' quad. has been mapped in detail. ACD: 1974.

D. M. HOSKINS, Pa. Geol. Survey. Geology and Mineral Resources of the Millersburg 15' Quad. [central Pa.]. ACD: 1974.

D. M. LAPHAM, Pa. Geol. Survey. The Serpentinites and Associated Rocks of Lancaster Co., Pa. ACD: 1976 or later.

D. B. MACLACHLAN, Pa. Geol. Survey. Geology of the Reading 15' Quad.

S. I. ROOT, Pa. Geol. Survey. Geology and Mineral Resources of the Mechanicsburg and Carlisle 7½' Quads. Plan to prepare a reconnaissance geologic map of Cumberland County in cooperation with A. Becher and W. Wetterhall of U.S.G.S.

A. W. ROSE, The Pa. State Univ., and HARRY CROUSE, D'Appolonia Assoc. Coal Resources, Pine Creek Drainage [Lycoming and Tioga Cos.]. ACD: 1974.

A. W. ROSE and H. W. SCHASSE, The Pa. State Univ. Geology and Mineral Deposits, Butler Knob and Adjacent Quads., Huntingdon Co. The relationship of sulfides to structure and stratigraphy is under study. ACD: 1974.

S. P. SCHWEINFURTH, U.S. Geol. Survey. Claysville-Avella [Washington Co.]. In preparation: Geology of the Avella quad. and part of the Steubenville East quad.

W. D. SEVON and T. M. BERG, Pa. Geol. Survey, and L. D. SCHULTZ, Lehigh Univ. Geology, Mineral Resources and Environmental Characteristics of Pike Co., Pa. Field work, including extensive sampling and analysis of surficial deposits, will be completed during the 1974 field season.

R. B. WELLS and R. T. FAILL, Pa. Geol. Survey. Geology and Mineral Resources of Montoursville North and Huntersville Quads., Lycoming Co. ACD: 1974.

G. H. WOOD, JR., U.S. Geol. Survey. Southern Anthracite Field. Limited field checking will continue in the area of the Weatherly 7½' quad. A geologic map of anthracite in the Nesquehoning 7½' quad. is being prepared for publication.

ECONOMIC GEOLOGY

THOMAS ARKLE, JR., C. W. LOTZ, JR., ROBERT REPPERT, FORREST JONES, ALAN KEISER and MICHAEL ROSCOE, W.Va. Geol. and Econ. Survey. Coal Resources Investigation and Pollution Potential Study. Maps of surface and underground mines and existing data on coal by seams are being compiled, and field parties are conducting geologic work and collecting additional data on the physical and chemical characteristics of coal seams and associated rocks. ACD: 1983.

ERNST CLOOS, Johns Hopkins Univ. Geology of the Thomasville area, York Co.

J. L. CRAFT, Pa. Geol. Survey. Quality of Glacial Gravels in the Franklin-Warren Area. Objectives are to obtain a better understanding of composition of land-based gravel deposits in the Franklin-Warren area; to develop a method whereby prime exploration targets for quality gravel can be identified; and to look for methods of upgrading low-quality gravel to high-quality gravel. ACD: 1975.

J. M. DENNISON, Univ. of N.C. Factors Favoring Uranium Protore in Fluvial or Probably Fluvial Strata of Precambrian and Paleozoic Age in Pa., Ohio, N.Y., and N.J. Summary based on literature study and field investigation to delimit distribution and character of fluvial and possibly fluvial strata, seeking relationships favorable for uranium. ACD: 1974.

J. C. GRIFFITHS, The Pa. State Univ. Value of Mineral Resources of Pa. ACD: 1975-76.

W. S. LYTLE, LAJOS BALOGH and LILLIAN HEEREN, Pa. Geol. Survey. Oil and Gas Field Map of Pa. The 1963 map will be updated as of June 1974. ACD: 1975.

W. S. LYTLE and LILLIAN HEEREN, Pa. Geol. Survey. Oil and Gas Pipelines in Pa. The October 1972 oil pipelines and gas pipelines maps will be brought up to date as of June 1974 at a scale of 1:500,000. ACD: 1974.

W. S. LYTLE, Pa. Geol. Survey, and petroleum engineers with oil companies in Pa. Updating of Mineral Resource Rept. 32, Crude Oil Reserves of Pa. New data will be used to update the 1947 reserve figures to the present. ACD: 1974.

B. J. O'NEILL, JR., Pa. Geol. Survey. Limestones in Pa. with Potential for Use in Stack-Gas-Removal (SO_X) Systems. ACD: 1974.

B. J. O'NEILL, JR., Pa. Geol. Survey. Properties and Uses of Shales and Clays in Southwestern Pa. A continuation of the series of programmed studies to evaluate the economic potential of shale-clay raw materials for ceramic and non-ceramic uses. ACD: 1974.

A. W. ROSE and P. DEINES, The Pa. State Univ., and D. C. HERRICK, Univ. of Alberta. Mineralogy and Isotope Geochemistry of Cornwall-type Magnetite Deposits. Magnetite and calcite samples from Dillsburg, Grace Mine, French Creek, and Boyertown are being analyzed for O^{18} to determine if the very heavy values found for Cornwall are typical. Sulfur isotope analyses have also been run. ACD: 1974.

M. S. SILVERMAN, Univ. of Toledo. Determination of Mineralization Controls by Geochemical Analysis of Soils Along Fracture Zones in the Northern Shenandoah Valley. It is hoped that this project will help in determining whether or not fracture zones have localizers for sulfide mineralization in this stratigraphic and tectonic setting. ACD: 1975.

R. C. SMITH, II, Pa. Geol. Survey. Lead and Zinc Occurrences of Pa. [central and S.E. Pa.]. Occurrences of sphalerite and/or galena are being located, described, and sampled. Field studies have been completed for many occurrences and the open-file status of most reports will be announced in late 1974. ACD: 1975.

W. R. WAGNER, Pa. Geol. Survey. Revised Surface Structure Map of Greater Pittsburgh Area and Its Relation to Oil and Gas Fields. Anticipated publication date is 1975.

WALLACE deWITT, JR., A. G. EPSTEIN, L. D. HARRIS, R. L. MILLER, and W. J. PERRY, U.S. Geol. Survey. Appalachian Basin Oil and Gas Resources. Objectives: To prepare a synthesis of the Appalachian basin evaluating the petroleum potential, to delineate potentially productive areas within selected lithofacies or stratigraphic units, to designate areas for local intensive study, and to encourage exploratory drilling in the untested parts of the basin. ACD: 1980.

ENVIRONMENTAL GEOLOGY

S. S. ALEXANDER, D. P. GOLD and J. DEIN, The Pa. State Univ. Applications of ERTS-1 Remote Sensing to Strip Mine and Acid-Mine Drainage Problems in Pa. [W. Branch of Susquehanna, Kylertown area]. The objective is to assess the usefulness of ERTS-1 data for (1) monitoring the areal extent of stripping for coal, (2) detecting areas adversely affected by acid-mine drainage, and (3) determining the effectiveness of reclamation and abatement procedures. ACD: 1975.

D. H. BATIPPS, A. W. Martin Associates, Inc. Crum Creek Water Quality Study. The purpose of this study is to determine the effect of proposed highway construction of L.R. 1010, Section B-1, Delaware Co., on the turbidity and sediment load entering the Crum Creek Reservoir of the Philadelphia Suburban Water Co. ACD: 1976.

W. W. BECK, JR. and R. W. KANE, A. W. Martin Associates, Inc. Relationship between Underground Mine Water Pools and Subsidence in the Northeastern Pa. Anthracite Fields. Study concerns the determination of critical mine pool factors that define the relationship between mine pool water level fluctuations and surface subsidence. ACD: 1974.

R. P. BRIGGS, U.S. Geol. Survey. Element A of USGS-Appalachian Regional Commission Project: Inventory of Disturbed Ground, Allegheny Co. Objectives are to inventory landslides, mining effects, and other earth disturbance features by means of aerial photographs and field verification, thus identifying actual and potential problem areas in Allegheny Co. The completion of field work is scheduled this year.

R. P. BRIGGS, U.S. Geol. Survey. Element D of USGS-Appalachian Regional Commission Project: Integration of Element A with Existing Data, Allegheny Co. The purpose of this project is to integrate new data from other elements with existing data and interpret them to produce derivative maps aimed at improved land and resource use.

R. P. BRIGGS, U.S. Geol. Survey. Greater Pittsburgh Regional Studies. Laboratory activities this year will include compilation of geologic, hydrologic, topographic, soils, land use, mining, and resource data; analysis, evaluation, and interpretation of data. A wide variety of environmental and derivative maps are being prepared for the Greater Pittsburgh region. A report on regional nutrient water-quality reconnaissance, and a drainage gazetteer of streams, dams, and water-measuring locations are being prepared.

JOE FISCHER, Dames and Moore. Geology and Seismology, Fulton Generating Station [Fulton Township, Pa.].

J. F. WEHMILLER, Univ. of Delaware. Stream Channel Morphology, Rocky Run, Delaware Co., Pa. ACD: 1974.

GENERAL GEOLOGY

G. O. W. KREMP, Univ. of Ariz. A Re-evaluation of Global Plantgeographic Provinces of the Late Paleozoic. A research project concerning the climatological and plantgeographic situation of Pa. in the Late Paleozoic.

GEOCHEMISTRY

D. M. LEWIS and K. K. TUREKIAN, Yale Univ. Natural and Man-Induced Controls of the Geochemistry of a Major River: The Susquehanna River. ACD: 1975.

A. W. ROSE, The Pa. State Univ., and D. I. PENNINGTON, Sanders and Thomas. Uses of Geochemical Exploration to Locate Chrome Ores, State Line District, Lancaster, Pa. ACD: 1975.

F. M. SWAIN, Univ. of Minn. and Univ. of Del. Low Temperature Pyrolysis of Devonian Shales [central Pa.]. It is the purpose of the present research to determine quantitative and qualitative yields of hydrocarbons when the shales are subjected to low temperature pyrolysis. ACD: 1975.

J. F. WEHMILLER, Univ. of Del., and THOMAS CAHILL, Tri-County Conservancy. Geochemistry of Pristine Watersheds, Brandywine Basin. ACD: 1975.

R. W. WHITE, U.S. Geol. Survey. Dispersion of Elements in the Zone of Weathering [quarry of John T. Dyer, two miles west of Birdsboro, Pa.]. The weathered profile on diabase has been sampled as a part of a topical study of the geochemistry and mineralogy of weathering of diabase in N.J., Pa., Va., and N.C., and of basaltic rocks in several western states. ACD: 1975.

GEOMORPHOLOGY

W. B. WHITE, The Pa. State Univ. Caves of Pa. A complete compilation of short descriptions and geological interpretation of the limestone caves of Pa. is underway. A volume of western Pa. caves is complete and work on central Pa. is now underway.

GEOPHYSICS

S. S. ALEXANDER, P. M. LAVIN, M. G. JUSTICE and S. J. GALIETTE, The Pa. State Univ. Mapping Overburden Thickness in Limestone Regions [central Pa. (State Coll. area)]. Conventional seismic refraction surveying was done to estimate soil velocities and thicknesses between drill holes in a limestone region. Further work is in progress to use seismic surface waves to infer the in-situ density, shear modulus, and Young's modulus of the soil. ACD: 1975.

W. A. CRAWFORD, Bryn Mawr Coll., J. H. KALMBACH, Harvard Univ., and J. L. FRIEDBERG, Aeroservice Corp. Magnetic and Gravity Profiles across the Honey Brook Anorthosite [N. half, Wagontown quad., S.E. Pa.]. We hope to be able to make some statements about the size and shape of the anorthosite body and the nature of its contact with adjacent country rocks. ACD: 1974.

R. J. GREENFIELD and CHARLES STOYER, The Pa. State Univ. Use of Electromagnetic and Electrical Methods to Study Ground Water Pollution by Acid Mine Water. A geophysical survey was made in Kylertown, Pa., in an area where the ground water is polluted with acid mine drainage. It was demonstrated that fracture traces which act as conduits for ground-water flow can be located with electromagnetic surveying methods. ACD: 1974.

JOHN HENDERSON, U.S. Geol. Survey. Aeromagnetic mapping for Pa. at 1:250,000 has been completed. Four maps for the central and northern part of the State are being prepared for open-file release.

B. F. HOWELL, JR., The Pa. State Univ. Relative Seismic Hazard in the U.S. Maps of Cumulative Seismic Hazard Index based on past seismicity have been prepared and values of Average Regional Seismic Hazard Index (ARSHI) found from these data. Values of expectable recurrence intervals of earthquakes of different sizes are being sought.

J. C. HOWER, Ohio State Univ. Paleomagnetism of the Ordovician Igneous Rocks of Lebanon Co., Pa. [Jonestown-Mt. Zion-Bunker Hill]. ACD: 1975.

P. M. LAVIN and M. A. SCANLIN, The Pa. State Univ. Regional Gravity and Magnetic Surveys. Regional gravity and total magnetic field intensity surveys were conducted along a traverse across Mine Ridge anticline and extending from New Holland to Oxford, Pa. Quantitative interpretation of the anomalies is in progress. ACD: 1974.

M. L. SBAR and L. R. SYKES, Lamont-Doherty Geol. Observatory. Study of the Seismicity in the Vicinity of the Proposed Tocks Island Dam [Delaware Water Gap].

K. W. VOLK and P. M. LAVIN, The Pa. State Univ. Paleomagnetism of Mesozoic Intrusives in Southeastern Pa. The paleomagnetism of diabase bodies is being used to determine the detailed late-stage tectonic history of the Triassic Basin. ACD: 1975.

GLACIAL GEOLOGY

D. R. COATES, SUNY at Binghamton. Reappraisal of the Glaciated Appalachian Plateau. ACD: 1974.

D. R. COATES and J. T. KIRKLAND, SUNY at Binghamton. Applications of a Glacial Model for Large-Scale Terrain Derangements [Glaciated Appalachian Plateau in N.Y. and Pa.]. The correlation of topographic anomalies and glacial deposits with a theoretically derived ice model suggests a new approach to glaciation in a rugged terrain. ACD: 1974.

G. H. CROWL, Ohio Wesleyan Univ. The Late Wisconsinan Glacial Border in Northeast Pa. Border has been remapped from the Appalachian Front north of Benton almost to Trout Run, a part of a larger project extending northwest from the Lehigh R. near White Haven. ACD: 1974.

HYDROLOGY

R. M. FOOSE, Amherst Coll. Determination of Hydrogeologic Parameters of Carbonate Rocks in Hershey Valley (Porosity, Permeability,

Specific Yield, Transmissibility). Through a series of pump tests and the measurement of more than 25 points of observation in a two-week time period, and 6 points of observation by continuous recording, an understanding of all the parameters that affect the behavior of water in several carbonate formations (Ordovician age) is being developed.

A. R. GEYER and E. T. SHUSTER, Pa. Geol. Survey. General Geology and Ground Water for Subbasins in the State Water Plan. This project will result in a description of the hydrologic properties of the various rock units in each subbasin of the State Water Plan. Only existing data will be used. ACD: 1974.

E. T. SHUSTER, Pa. Geol. Survey. Hydrogeology of the DuBois Area, Jefferson and Clearfield Cos.

E. L. WHITE, The Pa. State Univ. Flood Hydrology of Carbonate Watersheds in the Appalachian Mtns. The objective is to devise a model which will relate the flood behavior with geomorphic parameters of drainage basins in carbonate terrains. ACD: 1975.

C. R. WOOD, U.S. Geol. Survey, and D. B. MACLACHLAN, Pa. Geol. Survey. Geology and Hydrology of Northern Berks Co. ACD: 1974.

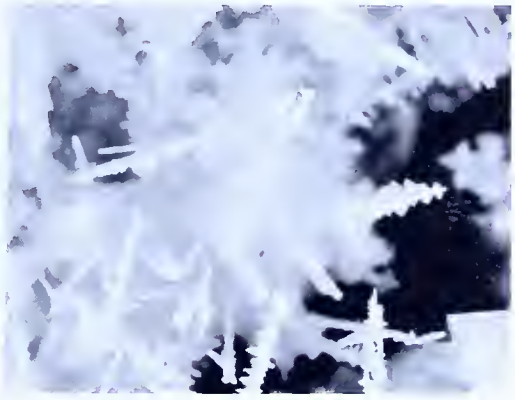
IGNEOUS AND METAMORPHIC PETROLOGY

M. L. CRAWFORD and ROB KUHLMAN, Bryn Mawr Coll. Mapping and Petrology in the West Chester and Coatesville 15' Quads.

A. A. DRAKE, JR. and R. I. TILLING, U.S. Geol. Survey. Petrochemistry of the Precambrian Rocks of the Reading Prong [eastern Pa., northern N.J., southern N.Y.]. ACD: 1980.

J. R. HUNTSMAN and W. A. CRAWFORD, Bryn Mawr Coll. The Petrology of the Country Rocks in the Honey Brook Anorthosite Area, Chester Co. ACD: 1975.

D. A. YOUNG, Univ. of N.C. Studies of the Baltimore Gneiss in the Philadelphia Area. ACD: 1975.



MINERALOGY

J. H. BARNES and D. M. LAPHAM, Pa. Geol. Survey, and WAYNE F. DOWNEY, JR., Juniata Coll. Mineralogy Associated with Burning Anthracite Deposits. A report on minerals forming from sublimation of gases produced by subsurface fires in anthracite mines and culm banks in Luzerne, Schuylkill and northern Dauphin Cos. ACD: 1974.

R. W. GRANT and ARTHUR MONTGOMERY, Lafayette Coll. Investigation of Pa. Minerals. Investigation of older occurrences, where data are incomplete, and occurrences of minerals new to the State. We are currently compiling an updated and validated list of Pa. minerals.

D. M. LAPHAM, J. H. BARNES and A. R. GEYER, Pa. Geol. Survey. Mineral Collecting in Pa. An updating and revision of General Geology Rept. 33, including addition of information on minerals, mineral collecting, and related geology for significant localities in Pa. ACD: 1976.

D. K. SMITH, The Pa. State Univ., and R. C. HAEFNER, SUNY at New Paltz. Identification of New Minerals from Cedar Hill Quarry, Lancaster Co. Two new copper minerals have been recognized in the serpentine bodies in southern Lancaster Co. We are attempting to obtain detailed chemical and crystallographic data in order to adequately validate them as new minerals.

D. K. SMITH, The Pa. State Univ., and D. C. OSWALD, Carnegie Museum. Crystal Structures of the Polymorphs of ZnS. Polymorphic forms of wurtzite have been described from the clay-ironstone concretions found in the Brush Creek limestone of the Conemaugh Fm.

of Pennsylvanian age. If X-ray diffraction proves that the crystals are pure polymorphs, their crystal structures will be determined to see if there are any detectable differences in the basic structure of the layers.

PALEONTOLOGY

MARIANNE ABLE and H. W. PFEFFERKORN, Univ. of Pa. History of Paleobotany in Pa. Development of Pa. paleobotany (including palynology) and complete bibliography. ACD: 1974-75.

J. R. BEERBOWER, H. E. ROBERSON, J. D. GRIERSON and I. KARCZ, SUNY at Binghamton. Devonian Terrestrial Habitats and Evolution of Terrestrial Communities. An investigation of the various terrestrial habitats represented in middle and late Devonian rocks in Pa., N.Y., and the Maritime provinces. Will involve combined paleontologic, paleobotanical, physical, sedimentological, and geochemical studies. ACD: 1975.

T. M. BERG, Pa. Geol. Survey. Pa. Geol. Survey Paleontology Collection. Work has begun on reestablishment of a reference collection.

T. M. BERG, Pa. Geol. Survey, and R. E. THOMS, Portland State Univ. Burrowing habits of *Archanodon* (Devonian) compared to *Margaritifera* (Holocene). Research has continued intermittently over the past year.

J. A. HARPER, Univ. of Pittsburgh. Gastropods of the Conemaugh Marine Events (Pennsylvanian) of the Appalachian Basin [W. Pa., W.Va., E. Ohio]. Samples will be processed for the recovery of micro- and macro-gastropods. A study will be made to determine if marine transgressive-stillstand-regressive phases result in any distinct evolutionary trends in the gastropods. ACD: 1976.

J. A. HARPER and H. B. ROLLINS, Univ. of Pittsburgh. New Ophiuroids (Echinodermata: Asterozoa) from the Brush Creek (Pennsyl-

vanian; Conemaugh) of Western Pa. Two ophiuroids from the Brush Creek marine shales of Punxsutawney are being described, and a study of the functional morphology of one is being prepared. ACD: 1974.

WARREN NORTON, Univ. of Pittsburgh. Paleoecology and Distribution of Foraminiferida in the Brush Creek Marine Event (Missourian; Pennsylvanian), Appalachian Basin [W. Pa., E. Ohio, W.Va.]. Pennsylvanian Formainiferida in the Brush Creek Marine Event show two major biofacies: a nearshore brackish-water fauna of arenaceous taxa in generally shaley sediments; and an offshore marine fauna of fusulinids and *Tetrataxis* in limey sediments. ACD: 1975.

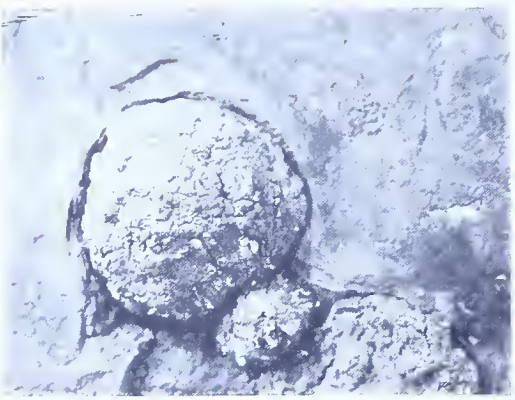
WARREN NORTON, Univ. of Pittsburgh. *Zatrachys serratus* Cope (Amphibia) from the Monongahela and Dunkard Groups [S.W. Pa., W.Va.]. Fragments of skulls and mandibles of the Permian amphibian *Zatrachys serratus* Cope, together with associated vertebrate remains, suggest that the Pennsylvanian-Permian boundary in the Appalachian Basin should be placed at the base of the Benwood Carbonate Mbr., Pittsburgh Fm. ACD: 1974.

W. A. OLIVER, JR., U.S. Geol. Survey. Corals of the Keyser Limestone.

H. G. RICHARDS and WILLIAM GALLAGHER, Acad. of Nat. Sci., Phila., and WILLIAM DARRAH, Gettysburg Coll. Preparation of Catalogue of Paleobotanical Collection of Academy [world-wide, but with many records from Pa.]. ACD: 1974.

H. B. ROLLINS and JACK DONAHUE, Univ. of Pittsburgh. Appalachian Basin Upper Pennsylvanian Marine Benthic Communities [Pa., Ohio, W.Va., Md.]. ACD: 1976.

ALFRED TRAVERSE and BRUCE CORNET, The Pa. State Univ. Palynostratigraphy of Newark Group Rocks of the Gettysburg and Newark Basins, Pa. Carnian-Norian (Triassic) palynofloras from the upper New Oxford Fm. of the Gettysburg basin and from the lower Brunswick Fm. of the Newark basin (Pa. and N.J.) are being compared with palynofloras of other Newark Group basins in N.C., Va., Conn., and Mass., in order to establish acceptable time-stratigraphic correlations between basins.



SEDIMENTOLOGY

J. D. GLAESER, The City Coll. of the City Univ. of N.Y. Control of Primary Sedimentary Structures in Uranium Accumulations in Devonian Catskill Deposits. ACD: 1974.

G. S. GOHN, Univ. of Delaware. Sedimentology of Cambrian Carbonate Rocks in Southeastern Pa. ACD: 1975.

C. J. ROTTMAN, Johns Hopkins Univ. Keefer Sandstone: Regional Variation in Grain Size, Shape and Compositon [Appalachian Valley and Ridge province from central Pa. to western Va.]. ACD: 1975-76.

STRATIGRAPHY

PING-FAN CHEN, W.Va. Geol. Survey. Stratigraphy, Paleogeography, Tectonics, and Oil Possibilities in Lower Paleozoic Rocks of Central Appalachians. ACD: 1974.

J. M. DENNISON, Univ. of N.C., and K. O. HASSON, East Tenn. State Univ. Hamilton Group Cross Section [from Ohio River to most

eastern outcrops in area 10 miles north or south of Mason and Dixon Line]. ACD: 1974.

W. E. EDMUNDS, A. D. GLOVER, V. W. SKEMA, J. D. INNERS, and M. A. SHOLES, Pa. Geol. Survey. Project TASIC. This project (Temporarily Available Stratigraphic Information Collection) is a continuing program involved with the recovery of stratigraphic data from active coal and clay strip mines and construction sites, while exposures are available. The long-term project is designed to provide data for future mapping and regional mineral resource evaluation.

LOUIS HEYMAN, Pa. Geol. Survey. The Oriskany Sandstone and Related Rocks in the Subsurface of Pa. [western and northern half of Pa.]. ACD: 1975.

J. D. INNERS, Pa. Geol. Survey. Stratigraphy and Paleontology of the Onesquethaw Stage (Lower/Middle Devonian) in Pa. and Adjacent States. ACD: 1974.

W. E. NUNAN, Univ. of N.C. at Chapel Hill. Stratigraphy and Sedimentology of the Loudoun and Weverton Fms. on the West Side of the Blue Ridge Anticlinorium, Waynesboro, Va., to Mechanicsburg, Pa. ACD: 1975.

D. B. TATLOCK, The Peoples Natural Gas Co. Upper Devonian Stratigraphy and Production Potential: Pa. ACD: 1974.

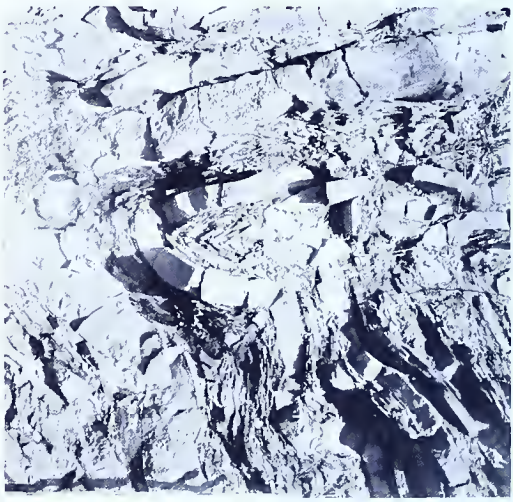
ALFRED TRAVERSE and R. R. WILSON, The Pa. State Univ. Palynostratigraphy of Uppermost Devonian to Lower Pottsville Rocks of the Allegheny Plateau of West-Central Pa. Objective: To define more precisely the time-stratigraphic relationships within the stratigraphic sequence.

J. S. UTTLEY, Ohio State Univ. Stratigraphy of the Maxville Group and Correlative Strata in Ohio, Pa., and W.Va. A subsurface regional study of the post-Waverly (Mississippian) pre-Pennsylvanian carbonate section of Ohio and neighboring states. ACD: 1974.

W. R. WAGNER, Pa. Geol. Survey. Growth Faults in the Cambrian and Lower Ordovician Rocks of Western Pa. Cambrian and Lower Ordovician growth faults define a new northeast-southwest-trending basin between northwestern Pa. and the outcrop belt in central Pa.

R. B. WELLS, R. T. FAILL and D. M. HOSKINS, Pa. Geol. Survey. Middle Devonian Stratigraphy in Central Pa.: A Revision [Mifflintown, Millerstown, and Millersburg 15′ quads.]. ACD: 1974.

D. L. WOODROW, Hobart and William Smith Colls., and FRANK FLETCHER, Susquehanna Univ. Upper Devonian Stratigraphy in Northeast Pa. This project will result in a stratigraphic synthesis of the N.Y./Pa. border areas from Milford/Port Jervis to Tioga/Corning. Surface and subsurface data are included. ACD: 1975.



STRUCTURE

W. E. EDMUNDS, W. R. WAGNER, LOUIS HEYMAN, Pa. Geol. Survey, and J. A. HARPER, Univ. of Pittsburgh. Revised Surface Structure Map of Greater Pittsburgh Area. Map at scale of 1:125,000 prepared for Greater Pittsburgh Regional Studies program of U.S. Geol. Survey. ACD: 1975.

R. T. FAILL, Pa. Geol. Survey. Fossil Deformation in Valley and Ridge Province. Fossils throughout the province exhibit angular and shape distortions caused by a penetrative deformation. To evaluate this deformation, crinoid columns have been collected across the province, and are in the process of being measured. ACD: 1974.

PETER GEISER, Univ. of Conn. Structural Study of the Appalachian Bend in Md. and Pa. Divergence of fabric axis of cleavage and bedding in the Bloomsburg Fm. varies systematically on the scale of a single first-order fold. The relationship of this variation to the Appalachian bend is being investigated. ACD: 1975.

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("PUBLICATIONS IN PRESS" will be published in October, 1974 issue.)

ANNUAL FIELD CONFERENCE
OF
PENNSYLVANIA GEOLOGISTS

October 4-5, 1974
Piedmont geology near Philadelphia
Hosts: Bryn Mawr College
Write for pre-registration forms to the: Field Conference of Pa. Geologists, c/o Pennsylvania Geological Survey, 418 Towne House, 660 Boas Street, Harrisburg, Pa. 17102.

FROM THE DESK OF THE STATE GEOLOGIST (continued)

It is good to see that the use and need for geology is increasing. Geologists in turn must respond to the challenge to provide more data for the areas where such information is needed now and to present the data in a format that will serve the users. To that end, the Pennsylvania Geological Survey is conducting geological investigations in the Pittsburgh, Harrisburg, Williamsport, York, Reading, and Altoona metropolitan areas. Our aim is to produce geologic data and maps which will serve the surface and subsurface development activities of those areas.

Arthur A. Socolow

SURVEY ANNOUNCEMENTS

BLAIR-HUNTINGDON COUNTY ZINC-LEAD DATA ON OPEN FILE

The Pennsylvania Geological Survey will place on open file on September 9, 1974, geologic data which has been compiled on certain zinc and lead occurrences in Blair and Huntingdon Counties. One occurrence to be included in the released data is an abandoned limonite iron mine in the Beekmantown Group of Blair County from which a composite limonite sample was found to contain 1.6% zinc. Other occurrences covered in the new data include mineralization within the Bellefonte, Nittany, Tuscarora, and Tonoloway Formations. Trace element analysis of limonite occurrences in approximately fifty abandoned iron mines of central and southeastern Pennsylvania suggest that a few of these sites may actually be zinc gossans.

The open file data will be available for examination at the offices of the Pennsylvania Geological Survey, 419 Towne House Apartments, 660 Boas Street, Harrisburg, after 9 A.M., September 9, 1974.

CLAY AND SHALE RESOURCES IN THE GREATER PITTSBURGH REGION– PHASE IV ON OPEN FILE

The Bureau of Topographic and Geologic Survey, Department of Environmental Resources, in cooperation with the U. S. Geological Survey is continuing a multi-purpose clay-shale program under the Greater Pittsburgh Regional Studies Program.

Phase I of this program was a comprehensive compilation of existing lithologic, physical, chemical, mineralogic, and use data on clay-shale samples from six counties in the Greater Pittsburgh Region. Phase II of the program consisted of the collection of 162 additional clay-shale samples. The results of the tests and chemical analyses for these 162 constituted Phase III.

Under Phase IV, 28 samples that indicated a promising potential as a source of lightweight aggregate were recollected on a bulk basis (200 lb. sample) and tested in a pilot-plant-size rotary kiln. The results of these tests together with chemical analyses for arsenic and organic carbon for 162 samples, and for mercury for 51 samples are presented in the Phase IV report.

This report is now on open file at three locations: Bureau of Topographic and Geologic Survey, Room 419 Towne House Apartments, Harrisburg; the Survey's regional office at 1201 Kossman Building, Pittsburgh; and the U. S. Geological Survey, 102 East Mall, Carnegie. All interested persons are encouraged to examine this report at any of these locations.

PREVENTION OF ROOF FALL IN COAL MINES

Designed to help prevent the serious problem of roof fall in coal mines, the Pennsylvania Geological Survey has issued GEOLOGIC CAUSES AND POSSIBLE PREVENTIONS OF ROOF FALL IN ROOM-AND-PILLAR COAL MINES by Bion H. Kent. This report presents geologic information relating to the causes of shale roof falls and suggests ways to minimize the danger. The data have been gathered in active mining areas of Green County, Pennsylvania. Similar types of data can be collected and utilized in a wide variety of locations and situations.

Bulletin IC 75 is available for $0.75 plus 6% sales tax for Pennsylvania residents from the Pennsylvania State Book Store, P.O. Box 1365, Harrisburg, Pa. 17125.

NEW REPORT ON DEVONIAN STRATIGRAPHY

The Pennsylvania Geologic Survey has issued Bulletin G63, UPPER DEVONIAN STRATIGRAPHY AND SEDIMENTARY ENVIRONMENTS IN NORTHEASTERN PENNSYLVANIA by J. Douglas Glaeser. Based on surface data and lithologic records from 14 deep wells in the region, this report develops a three-dimensional picture of the nature and distribution of the complex sedimentary environments represented by Upper Devonian rocks in Northeastern Pennsylvania.

This comprehensive report provides a value basis on which to prospect for oil and gas, groundwater, and possible uranium mineralization. It will also serve the needs of such applied geology as solid and liquid waste disposal, ground water recharge, and engineering construction design.

Bulletin G63, with 89 pages and a full-color correlation diagram, is available for $4.30, plus 6% sales tax, from the Pennsylvania State Book Store, P. O. Box 1365, Harrisburg, Pa. 17125.

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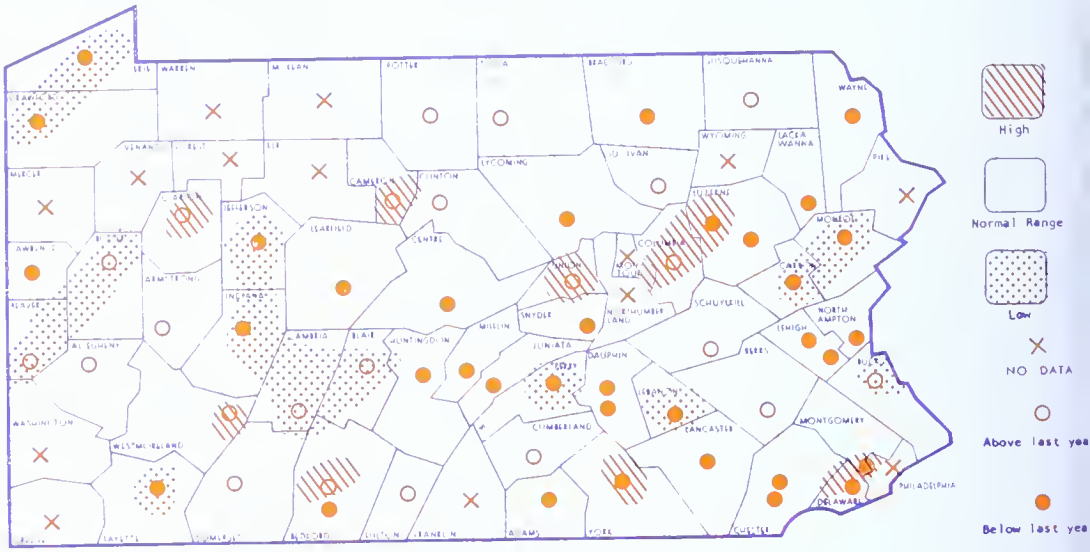
JULY 1974

GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120

CORRECT ADDRESS REQUEST

PENNSYLVANIA GEOLOGY

THE PENNSYLVANIA GEOLOGICAL SURVEY

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Pothole development in sandstone along one of Pennsylvania's babbling brooks. Photo courtesy of Grant Heilman, Lititz, Pa.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

OCTOBER 1974

FROM THE DESK
OF THE
STATE GEOLOGIST . .

THEY'LL DIG SOME UP SOMEWHERE

Several years ago one of my favorite comic strips featured a dialogue in which one character asked "What will they do when they run out of minerals?" The reply by another character in the strip was "Oh, they'll dig some up somewhere." That reply fairly well epitomizes what so many people actually believe today. However, those of us who work with the problems of finding new mineral resources and who are also concerned with protecting the environment know that it's just not as simple as digging some up somewhere.

We find ourselves in a society that having already consumed the easily found, high grade mineral resources, now continues to demand ever-increasing quantities of all varieties of mineral resources. This is a society whose housing, industry, transportation, tools, clothing, household appliances, and energy fuels are all derived from mineral resources. This growing demand is not only a phenomenon of the United States and other industrial nations, but of the underdeveloped countries as well who are striving to catch up.

Even as the demands for mineral resources grow, the restraints on availability are increasing more rapidly. So we have foreign, mineral-exporting nations withholding production and sales in the interest of higher prices and extending longevity. Exploration and development of our own offshore oil, gas, and mineral resources is facing environmental opposition. Vast wilderness areas are being set aside, not to be disturbed by man-made developments of any kind, particularly mineral extraction. Restrictive zoning in urban and suburban areas is closing out quarries and mines from the very areas where the demand for mineral resources is greatest. Agricultural lands are being given special protection even as they are often located on top of uniquely high-grade limestone needed for steel making, lime, and pollution-controlling chemicals. Dredging minerals from rivers and the offshore is being restricted because it disturbs the fish. There is strong opposition to strip mining of coal (for what it does to the land) and deep mining of coal (for what it does to water) even as calculations show that our huge coal reserves are the most immediate solution to energy shortages. Even as there is opposition to mining coal and to burning coal, and even as there are crises of petroleum shortages and costs, there is also opposition to mining uranium which might fuel nuclear power plants.

Proponents for each of the restraints to mineral extraction present an appealing list of justifications. But the demand for more mineral resources still continues unabated. Just where are they going to be able to dig some up?

Arthur A. Socolow

UNSUSPECTED SOURCE OF WATER POLLUTION IN SOUTHWESTERN PENNSYLVANIA

By 1970, about eight hundred thousand acres had been stripped to mine various shallow coal seams in southwestern Pennsylvania. Constructing golf courses on these otherwise unproductive sites has been a popular way of reclaiming some of the scarred land. The golf courses are scenically pleasant and constitute, at the same time, a productive source of income.

The conversion of strip mines into golf courses is attractive because large tracts of land (a minimum of 160 acres are needed for a better than average golf site) that require minimum construction and maintenance are available at a relatively inexpensive price. However, the experience described here shows that before selecting an appropriate program of turf management, the geological and hydrological conditions should always be investigated in order to minimize the risk of polluting surface streams.

The following example describes the geological and hydrological conditions at an existing golf course and should attract attention to an otherwise unsuspected problem. This course was built on about 60 percent stripped land which had been recontoured with claystone and black-shale fragments containing pyrite, from the spoil piles. The only topsoil (a rich sandy loam) applied was to the tees and greens. The Redstone coal, approximately four feet thick in this area, is the seam that was stripped. The Pittsburgh coal, approximately six feet thick, is between 30 to 80 feet below the surface and had been mined from under the golf course and the surrounding areas. The local dip of the geological formations is approximately one degree to the southwest. The outcrop pattern and the structural contours on the base of the Pittsburgh seam are shown on Figure 1.

It is recognized by all golf course builders that a large supply of good quality water is critical in selecting a site for construction. This is evidenced by the fact that most courses are built near a stream or lake. In the case of the golf course under consideration, the ground crew pumps over 300,000 gallons of water in ten hours from an adjoining river. This water, which has an initial pH of 4.5 to 5, is treated with 300 to 400 pounds of soda ash and four pounds of chlorine to bring the pH up to 6.5. The amount of water sprayed on the Kentucky Blue Grass turf during the months of June, July, August and September, exceeds 2.5 million gallons per week. The water is usually applied overnight. There are two reservoirs on the ground that con-

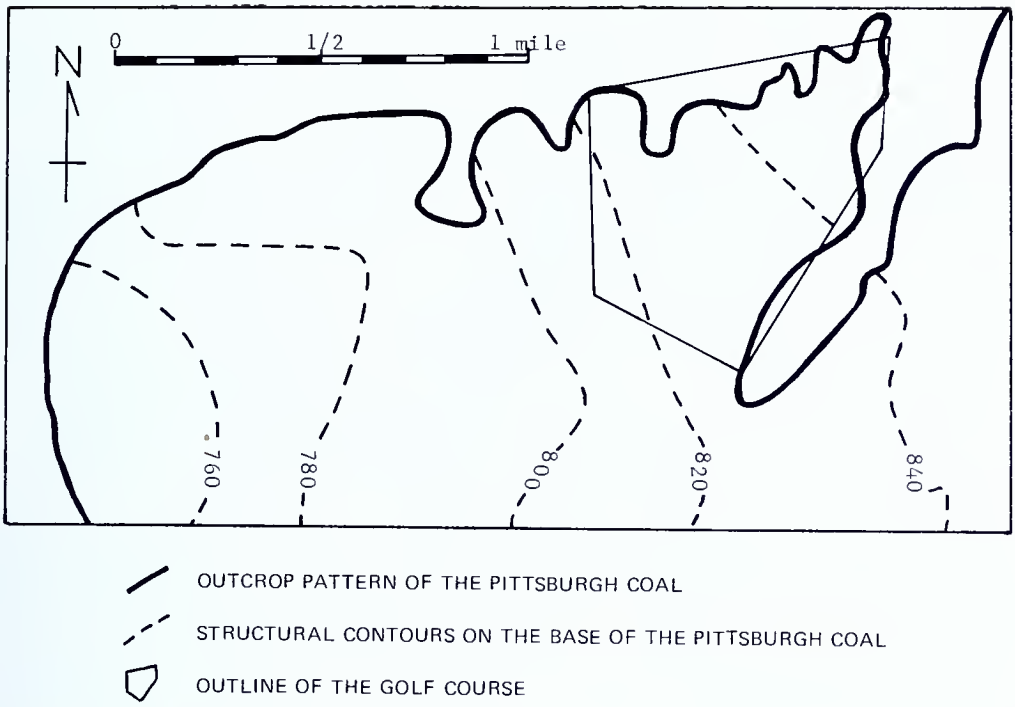


Figure 1. Outcrop pattern and structural contours on the base of the Pittsburgh coal.

tain a total of 3 million gallons of water. Consumption of water by turf depends on growth rate, sod density, depth of root systems, height of cut in addition to weather conditions such as rain, humidity, temperature and amount of evaporation caused by wind and sunshine. Estimated quantities lost by evaportranspiration range from less than 150,000 gallons to more than 500,000 gallons per week.

To better understand what happens to the excess amount of water that is sprayed on the greens, we should examine the sedimentary rock sequences in which coal occurs. These consist of successive beds of sandstone, shale, coal, clay, and sometimes limestone. An impervious clay layer usually lies under each coal seam. Most of the excess water that is applied to the turf every week percolates through the fill, the sandstone and shale into the underlying abandoned Pittsburgh-coal mine complex. There are also several sinkholes that funnel large amounts of excess water directly into the underlying mine complex. The fill, the shale and coal seam contain pyrite (iron sulfides). Contact with air and water produces sulfuric acid and iron sulfates. As the water flows through the fill and into the underground mine complex, it collects increasing amounts of sulfuric acid and ferric

hydroxide. The water flows in the direction of dip, on top of the impervious underclay, and surfaces a few miles away from the site of the golf course (Fig. 2). Therefore, it may be difficult for a casual observer to link the acid drainage from the mines with the excessive watering of the golf course. In this respect, it is interesting to note that the outflow of acid drainage, from the locations shown on Figure 2, dies down during the winter months and increases substantially during the summer months.

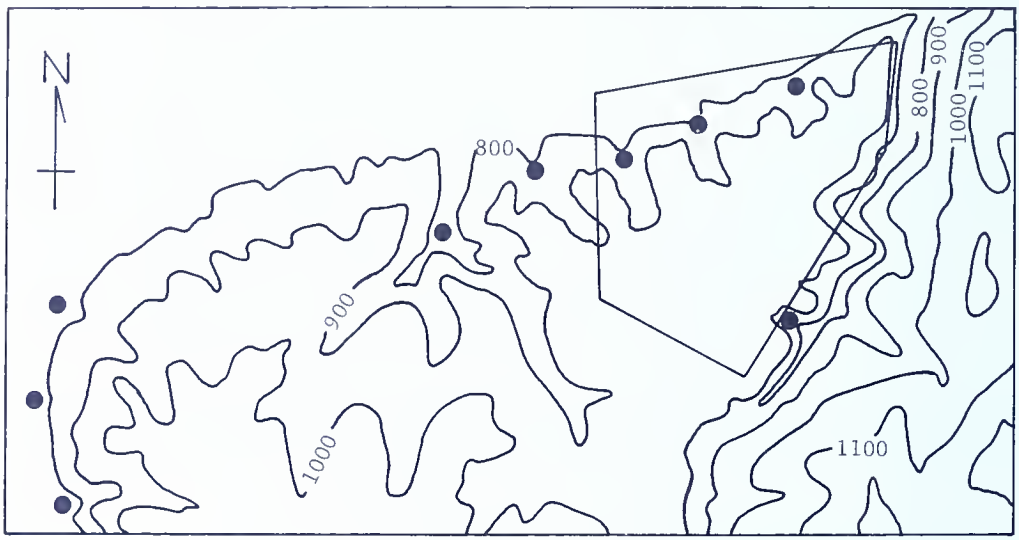


Figure 2. Topographic map of the golf course and surrounding areas.

This drainage problem is likely to occur in all areas where golf courses are built over shallow underground mines. Once the problem is recognized, it should be possible to design a turf management program in which the water is recycled through a closed drainage system. Such a system would permit the conservation of large amounts of water (in the millions of gallons per week), mitigate the use of chemicals (needed to increase the initial pH of the water), and stop the unchecked seepage of water into the underlying abandoned coal mines.

S. G. Khoury
Dames and Moore
Cranford, New Jersey
Richard M. Hipwell
Department of Earth and Planetary Sciences
University of Pittsburgh

MINING LAND USE STUDY PUBLISHED

Forty percent of all the land used for mining in the U. S. between 1930 and 1971 has either been reclaimed to meet existing legal requirements or restored to useful condition, according to a U.S. Bureau of Mines report just issued.

Total land used for mining during the 41-year period was 3,650,000 acres, or 0.16 percent of the country's total land area. During the same period, 1,460,000 acres used for mining was reclaimed. Total area of the 50 States is 2,271,304,000 acres.

Of the total land used for mining, about 59 percent was for actual excavation of minerals, according to the report. Of the rest, 20 percent was for disposal of overburden and wastes from surface mining operations, 13 percent was for disposal of processing wastes, 5 percent was for disposal of underground mine wastes, and 3 percent was land affected by subsidence or other disturbances from underground mining.

Total acreage used for mining from 1930 to 1971 is about equal to the area covered by railroads or airports at the end of 1971. Highways in the United States, by contrast, accounted for 22,700,000 acres, an area more than six times as large as that used in 42 years of mining.

Land was used for mining in each of the 50 States during the period studied. Pennsylvania, Illinois, Ohio, Kentucky, California, West Virginia, Indiana, Minnesota, Arizona, and Missouri each utilized over 100,000 acres for mining activities. Together these States accounted for almost 60 percent of all the land used for mining, and for more than two-thirds of all the mining land reclaimed.

Bituminous coal production was the heaviest user of land over the 41-year period, accounting for 40 percent of the total. Sand and gravel mining was next (18 percent), followed by stone (14 percent), clay (5 percent), copper (5 percent), iron ore (3 percent), and phosphate rock (2 percent). The remaining 13 percent was used by mines producing all the other mineral commodities (except oil and gas).

One million acres, or 68 percent, of the land that had been used for coal mining was reclaimed from 1930 to 1971, a larger total area and higher proportion than for any other commodity.

The report also describes and illustrates characteristics of the different surface mining methods. A 1930-71 summary is given for each State. Copies of "Land Utilization and Reclamation in the Mining Industry, 1930-71" (Bureau of Mines Information Circular 8642) can

be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402, for $1.05 each. Orders should specify the complete title, plus GPO Catalog No. I28.27:8642 and GPO Stock No. 2404-01601.

COSTS OF UNDERGROUND COAL PRODUCTION

Costs of starting and operating three hypothetical underground coal mines in 48-inch beds are estimated in a report just issued by the U.S. Bureau of Mines.

The report, second in a series, gives capital-investment and operating costs for hypothetical coal mines with annual production capacities of 1.03, 2.06, and 3.09 million tons per year (MM tpy). The estimates include wages and welfare benefits at current union rates, acquisition of mining rights to coal land, and materials and equipment at 1973 prices. All three are assumed to have a 20-year working life operating three shifts per day, 5 days per week.

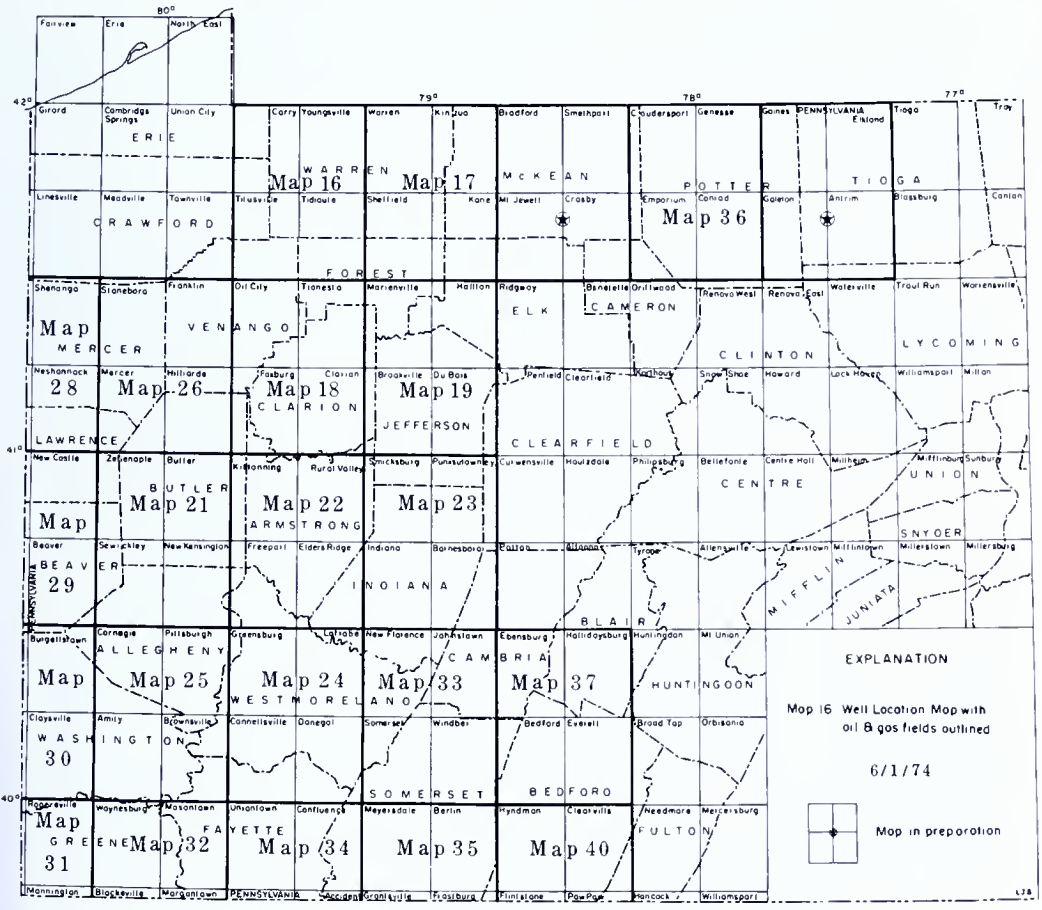
Initial capital investment would be $12,938,200 for the 1.03 MM tpy mine, $21,852,900 for the 2.06 MM tpy mine, and $31,435,500 for the 3.09 MM tpy mine. Annual operating costs for the three mines would be $7,821,300, $14,345,100, and $21,041,900, respectively. Assuming a 12-percent rate of return on investment (after Federal income taxes), the corresponding selling prices for coal from the mines would be $9.11, $8.27, and $8.06 per ton.

The mines would be multisection operations, with each section consisting of 10 miners plus a foreman, and each equipped with a continuous mining machine, a loading machine, two shuttle cars, and a roof bolting machine. Conveyor belt systems would carry the coal out of the mines. The three mines employ 254, 461, and 674 people, respectively.

Although the report tabulates all equipment, personnel, and costs for developing and operating the mines, the Bureau cautioned that the figures are only estimates. Because of many variables, actual costs for starting and operating a coal mine commercially will vary from location to location and year to year, the Bureau said.

NEW OIL AND GAS BASE MAP AVAILABLE

A new oil and gas base map, #40, is now available and twenty previously available maps have been updated as of June 1, 1974. Each base map encompasses four 15-minute topographic quadrangles and is at the scale of 1 inch equaling a mile and shows locations of oil and gas wells and the outlines of the oil and gas fields. Refer to index map. A five-minute grid, quadrangle names, county boundaries, and major rivers and towns make up the background of the base map. All deep wells known and all shallow wells on record with the Pennsylvania Geological Survey are located, and the status (dry, oil producing, gas producing, etc.) is shown by symbol. Deep wells (Tully Formation or deeper) are differentiated and elevation and total depth are shown. Symbols indicate the availability of geophysical log and sample data on open file in the Survey's Oil and Gas Division office in Pittsburgh. An index map with the legend shows the outlines of oil and gas fields within the mapped area, thus indicating areas of extensive pre-1956 drilling. A listing of the field names is also included.



Paper prints of the base maps can be obtained by writing to the State Book Store, P. O. Box 1365, Harrisburg, Pennsylvania 17125. The cost of each base map is $0.50, plus a 6 percent sales tax to Pennsylvania residents. A check for the appropriate total amount made out to the Commonwealth of Pennsylvania must accompany the order. When ordering, please specify the map number.

A cross index of state permit numbers with quadrangle map numbers used on the base maps is available from the Pittsburgh Branch of the Pennsylvania Geological Survey, 1201 Kossman Building, Stanwix Street, Pittsburgh, Pennsylvania 15222. This index is arranged by quadrangles. Please specify the quadrangle when requesting this literature.

New Faces in the Geologic Mapping Division

There are three new faces in the Geologic Mapping Division. Jon Inners and Mark Sholes reflect personnel changes and Viktoras Skema is a new staff addition. All three are engaged in studies related to coal distribution, environment of deposition, coal composition, and coal reserves.

Jon D. Inners, a native of central Pennsylvania, was awarded a B.A. degree in geology from Susquehanna University. He is currently completing a Ph.D. dissertation at the University of Massachusetts. His professional experience includes several years as an engineering geologist and soils engineer for various organizations. Professional interests include paleontology and stratigraphy; he also enjoys photography and nature.

Mark A. Sholes, raised in Iowa, received B.A. and M.A. degrees in geology from the University of Iowa, is completing a Ph.D. dissertation at the University of Texas. Mr. Sholes was an aerial photography analyst for the U. S. Army and maintains a keen interest in photography. He has worked as a student-assistant for the Iowa Geological Survey, and his professional interests include sedimentology, sedimentary petrology, and paleogeography.

Viktoras W. Skema, born in Senne, Germany, was raised in the Detroit area. He was recently awarded a B.S. in geology from Michigan Technological University, located in the scenic and mineral-rich upper peninsula. Mr. Skema was a draftsman for several years and is a Viet Nam veteran. Professional interests are centered about coal geology and he is an avid sports fan and participant.

SURVEY ANNOUNCEMENTS

SOURCES OF COARSE AGGREGATE IN THE FRANKLIN-WARREN REGION OF NORTHWESTERN PENNSYLVANIA—OPEN FILE REPORT

The Bureau of Topographic and Geologic Survey, Department of Environmental Resources, is releasing to open file a detailed compilation of sources of coarse aggregate within a 30-mile radius of Franklin and Warren, Pennsylvania. The source materials are sand and gravel deposits of glacial origin and the Vanport limestone.

The compilation includes: (1) location, type of operation, geologic environment, results of sodium sulfate (freeze and thaw) and Los Angeles rattler tests on coarse aggregate from active producers performed by the Pennsylvania Department of Transportation; (2) general results of exploration for gravel at a limited number of locations; (3) types of material (sand, gravel, clay, etc.) logged in drilled wells; and (4) locations of inactive sand and gravel pits. These data are presented in a series of seven tables with the location for each entry plotted on a map of the glacial deposits of northwestern Pennsylvania.

The released data should be especially helpful to those who plan to explore for coarse aggregate in the Franklin-Warren region. The compilation is on open file at the Bureau of Topographic and Geologic Survey, Room 419, Towne House Apartments, 660 Boas Street, Harrisburg, Pennsylvania. The material is available for inspection only as the size and hand coloring of the maps do not permit in-house reproduction.

CLAY-SHALE CHEMICAL ANALYSES, SOUTHWESTERN PENNSYLVANIA

Clay and shale chemical analyses for samples from southwestern Pennsylvania will be part of a comprehensive research program by the Pennsylvania Geologic Survey on clay and shale utilization throughout the state. The program consists of field selection, field sampling, geologic description, physical testing, ceramic properties testing, chemical analyses, mineral analyses, and use designations. To date, a comprehensive phase of statewide testing and a detailed study of clays and shales in southeastern Pennsylvania have been published (Bulletin M-63), as well as a broader sampling program throughout Pennsylvania (Bulletin M-51). The next research phase, on samples

from southwestern Pennsylvania, is nearing completion in cooperation with test data from the Tuscaloosa laboratory of the U.S. Bureau of Mines. Final phases of the program will encompass the remainder of the state and synthesize the results of the information developed, including data previously obtained and now being summarized in a clay-shale atlas.

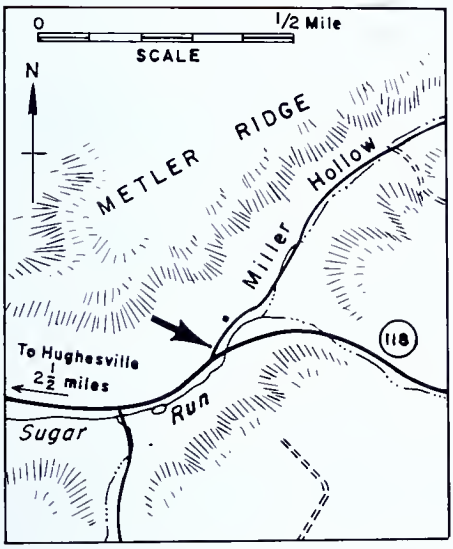
We anticipate that approximately 125-150 clay-shale samples from southwestern Pennsylvania will be collected and sent for physical and ceramic tests by this Fall. Upon return of splits of these samples from Tuscaloosa during the Fall and Winter of 1974-75, they will be available for quantitative chemical analyses. These analyses consist of quantitative major element and semiquantitative trace element determinations. The results of the chemical analyses will be correlated with other tested properties and with potential sample uses to aid in determining the controlling variables. Chemical data also are used as a check on mineralogical analyses. To date, chemical constituents have proved to be valuable indicators of quality and type of use for many potential products from Pennsylvania raw materials.

A PROGRAM OF LIMESTONE CHEMICAL ANALYSES

A compilation of chemical analyses of limestones in Pennsylvania through 1966 (Pa. Geol. Surv. M-50, Pt. I) revealed that the limestones of many areas are of unknown chemical composition. Such data are not only economically important, as well as useful stratigraphic and environmental indicators, but now have an additionally potential economic use in stack gas scrubbers to remove sulfur from coal used in power plant operation. Because the chemical specifications for the scrubber use of limestone differ from that for traditional high-calcium limestone, new and more geographically comprehensive sample analyses are required to define potential source areas.

The Pa. Geol. Survey currently is engaged in field geologic mapping in several areas where limestones are potentially economic but where chemical data are insufficient to delineate a utility. During the next year, about 150 samples will be collected for quantitative major element and semi-quantitative trace element analyses by our field geologists. Each sample is to be a chip composite of limestone beds of mineable thickness from areas deficient in published chemical analyses. The sampling program is expected to continue until sufficient coverage of the State is obtained to portray the potentially utilizable limestones and to determine significant lateral and vertical compositional variations. All resultant data will be published in topical resource reports or areal geologic bulletins.

NEW FOSSIL COLLECTING LOCALITY IN *LYCOMING COUNTY*



Easily accessible localities with abundant fossils are not common in Lycoming County. A new locality, however, has been discovered recently and was reported by Richard Wells, staff geologist of the Bureau of Topographic and Geologic Survey, as part of his mapping program of the area near Hughesville. The exposure was produced by recent construction and realignment of Pa. Route 118 where it parallels Little Sugar Run east of Hughesville.

The locality is approximately 2½ miles east of Hughesville at the site where a secondary road turns north into Miller Hollow. There is a large graveled parking area to the north of Route 118 where it joins the secondary road so that a large group could easily park. The fossils may be found in place in the road cut and in the loose blocks along Route 118, just south of the intersection. The cut is long, extending about 100 yards to the west of the intersection.

The rock exposed at the locality is the lower part of the Upper Devonian Period Brallier Formation and consists of layers of blocky sandstone interbedded with layers of shale and siltstone. The shalier layers are not as well cemented as the sandstone and weather easier. The weathering undermines the blocky layers causing them to fall. Although the slope of the exposure is steep, one can climb it. However, because the rock is loose, one should remain near the bottom to avoid a rock fall and possible injuries.

With few exceptions, the fossils are represented by molds and casts; all of the original shell material has been dissolved. Good specimens may be obtained, however, with a diligent search.

The following fossils have been identified from this locality:

Coral
- Aulopora

Pelecypod
- Paleoneilo

Miscellaneous
- Crinoid columnals
- Plant fragments
- Bryozoa

Cephalopod
- Orthoceras

Brachiopods
- Whidbornella
- Cyrtospirifer
- Mucrospirifer
- Chonetes
- Camerotoechia
- Schizophoria

Gastropod
- Halopea

Sketches of these fossils may be seen in Bulletin G40, Fossil Collecting in Pennsylvania. This may be purchased by sending $.50 plus tax to Department of Property and Supplies, Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.

Donald M. Hoskins

U.S. GEOLOGICAL SURVEY TO PREPARE NATIONAL LAND USE MAPS

In recognition of its historical role as the nation's primary mapping agency, the U. S. Geological Survey has announced plans to initiate within Fiscal Year 1974–75 a comprehensive land use mapping program which is to extend through to complete coverage of the United States by 1978. The mapping will be based on land use categories as identified in the U. S. Geological Survey Circular 671, with the national coverage to be carried out on the basis of the USG Level II categories.

The land use mapping will be based on the presently defined 1° by 2° quadrangle sheets. The land use data will be compiled at a scale of 1:125,000 and will utilize existing imagery, supplemented by new imagery where it is felt that the quality and recency is not adequate. The maps will be published and available to the public, with the scale of the final published maps to be at either 1:125,000 or 1:250,000.

This new land use inventory aims at defining the existing categories of land use and does not include recommendations or proposals for future land use. This comprehensive program is to be carried out by the new Office of Geographic Analysis and Applications within the U. S. Geological Survey. Director of that new office is James R. Balsley with headquarters at the U. S. Geological Survey National headquarters at Reston, Virginia.

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- Second Annual Report on the 1st Geological Exploration of the State of Pennsylvania. 1838
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- v. 2 1836

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- 1942-1953
- 1959-1966
- 1968-1969
- 1971

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Stanwix Street, Pittsburgh, Pa. 15222

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In Cooperation with The U.S. Geological Survey

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SEPTEMBER 1974

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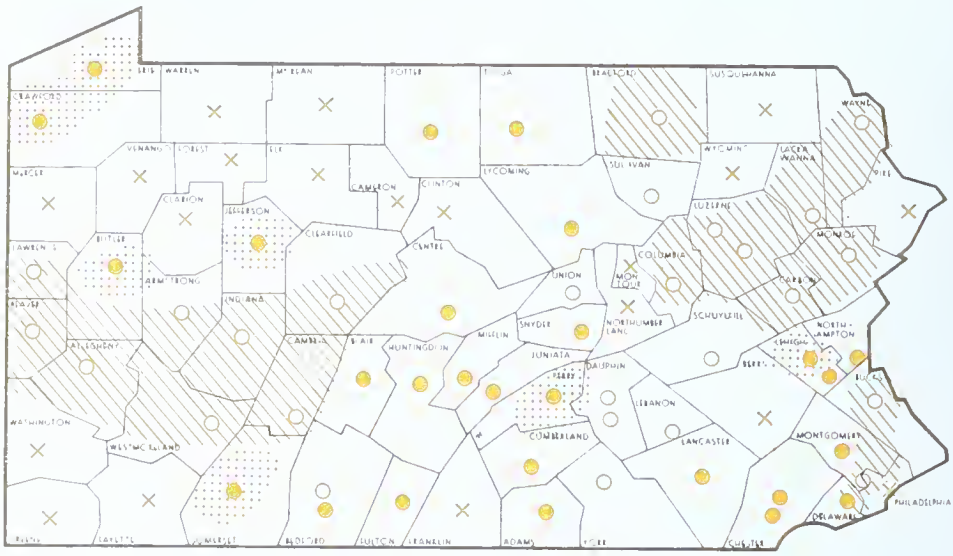

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PENNSYLVANIA GEOLOGY

THE PENNSYLVANIA GEOLOGICAL SURVEY

VOL. 5/6

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: One of Pennsylvania's large regions that are totally forested, with little or no impact on the landscape by man. View north of Slate Run. Photo courtesy of Grant Heilman, Lititz, Pa.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

DECEMBER 1974

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

WE'RE PUTTING THE COUNTY ON THE MAP

The first of a new series of county topographic maps are now available for five of Pennsylvania's counties, with more on the way. Responding to the need for recognizing our counties as discrete, viable units from the standpoint of political, industrial, planning, agricultural, and recreational activities, the Bureau of Topographic and Geologic Survey initiated this program and arranged for its implementation as a cooperative project with the U. S. Geological Survey's Topographic Division. This is the first such state-federal county mapping program in the country and already several other states have enthusiastically started similar programs.

The county topographic maps now available are Sullivan, Jefferson, Montour, Forest, and Lehigh. Nineteen other counties are in progress and should be available within a year. The ultimate goal, if our budget permits, is to have these maps available for every one of our counties. This program is possible for programming only because we have already completed statewide coverage of even more detailed quadrangle topographic maps. These up-to-date quadrangle maps now permit the preparation of county topographic maps at very low cost.

The new county topographic maps show all landforms, water bodies, and slopes (by contours), as well as roads, trails, major buildings, and other man-made features. Political boundaries are clearly defined, including township boundaries. The 1:50,000 scale of these county maps was chosen to satisfy the needs of those who want to have maps somewhat like the old inch to the mile series of 15-minute quadrangle maps which were discontinued. The 1:50,000 scale also keeps us in step with the trend for future maps to utilize the metric system.

We believe that these new maps will be of extensive use to government officials, planners, industry, engineers, and the public. The scale of these maps and their orientation to county programs should make them usable by a wide range of citizens.

The county topographic maps for Sullivan, Montour, Jefferson, and Forest counties may be purchased at $2.00 each from the Distribution Section, U. S. Geological Survey, 1200 S. Eads Street, Arlington, Virginia, 22202. The Lehigh map is available for $1.00 each (plus tax) from the Pennsylvania Bureau of Publications, 10th and Market Streets, Harrisburg, Pa. 17125.

Arthur A. Socolow

WALTER RICHARD WAGNER

(1928 - 1974)

It is with deep regret that we announce the death of our colleague and friend, Dick Wagner, a long-time senior geologist at the Pittsburgh branch office of the Pennsylvania Survey. Dick died suddenly on October 21, 1974 at his home in Bethel Park, Pennsylvania.

Walter Richard Wagner was born in Baltimore, Maryland on October 27, 1928. When he was very young, the family moved to Philadelphia, Pennsylvania. Dick graduated from the Lansdowne High School in 1946 and entered the service of his country in October of that year in the United States Army. At the conclusion of his Army service in 1948, Dick entered the University of Pennsylvania, where he was awarded a B.A. degree in Zoology in 1952. Later that year he started work on his M.A. degree in Geology at Bryn Mawr College, Bryn Mawr, Pennsylvania, receiving the degree in 1955 after completing his thesis on a statistical study of Miocene Molluscs in zones of the Calvert Foundation, Maryland. During the summer of 1953 Dick worked for the U. S. Geological Survey in the Minerals Deposit Branch panning for heavy minerals on the New Jersey, Maryland, and Virginia coastal plain.

After graduating in 1955, his first job was as a geologist in the testing laboratories of E. L. Conwell and Company of Philadelphia, where he worked for a year. Hired at that time by the Pennsylvania Bureau of Topographic and Geologic Survey, Dick continued to work for the Survey until his untimely death.

During the early part of his career with the Oil and Gas Geology Division of the Survey, Dick specialized in the study of Cambrian and Ordovician stratigraphy of the subsurface of western Pennsylvania and later the Upper Devonian to Conemaugh rocks of Pennsylvanian age. He found time to teach a night course on earth sciences at Point Park College in Pittsburgh from 1967 to 1969 and to attend the University of Pittsburgh in 1968-69.

His first publication after joining the Survey in 1956 was the description of the drill cuttings of a deep well in Snyder County, Pennsylvania. Descriptions of other wells followed and in 1959 his "Catalogue of Deep Well Samples and Geophysical Logs" was published by the Survey. One of his most outstanding contributions, "The Stratigraphy of the Cambrian to Middle Ordovician Rocks of Central and Western Pennsylvania" was published by the Survey in 1966. Dick was the single or senior author of ten Survey publications and junior author of fifteen. Seven reports were published in national journals; other reports of his are on open file and four are being prepared for publication.

Geology was Dick's avocation as well as his vocation. Except for being with his family, he enjoyed nothing better than to meet with his fellow geologists and talk shop. He was independent-minded and thorough, painstaking, meticulous, and very productive in his work. Dick was a philosopher with a quiet wit. His keen analytical mind produced conclusions that were based on a deliberate and thorough analysis of all the phases of a particular problem.

Dick was a member of the Geological Society of America, the American Association of Petroleum Geologists (a member of several committees), Pittsburgh Geological Society (President 1966-67), Northern Appalachian Geological Society, American Association for the Advancement of Science, and the Society of Sigma Xi. He gave numerous talks and was the leader of many field trips. His biography is included in Who's Who in the East, 13th Ed.

Dick is survived by his widow, Agnes; their five children, Susan, Richard, Karen, John, and Barbara. His friends and colleagues also feel a sense of deep personal loss by his departure. The Appalachian area geological fraternity has lost a highly valued member at the height of his career.

FETID BARITE FROM BERKS COUNTY, PENNSYLVANIA

Several tons of fetid barite nodules have been found scattered in the fields of the Roy McLain farm (formerly R. and M. Frantz farm) located 1.4 miles southeast of Frystown, Tulpehocken Township, Berks County. The main area of barite is about 1,000 feet west of the R. McLain house and there is a lesser concentration about 500 feet north of the house. This occurrence was shown to the author by Mr. Milt Leet of Blue Ball and Mr. Jan Wise of Myerstown.

The barite on the McLain farm occurs principally as nodules which consist either of millimeter-sized, tabular barite crystals (Photo 1) or coarse, crystal cleavages up to 5 inches long radiating from a common center (Photo 2). In a few cases, the tabular aggregate variety forms a core for the radiating variety. The radiating crystals often have a white to gray central zone down their length and a black rim. The irregular crystal cleavage surfaces through the nodules suggest deformation after formation, whereas the nodular habit suggests growth before lithification. Shale chips included in some of the nodules indicate that the nodules formed within the shaly rocks upon which they now lie. Of lesser importance by volume are white barite-calcite veins which cut limestone and probably represent post-lithification redistribution of barite, probably during the Taconic or Appalachian orogenies.

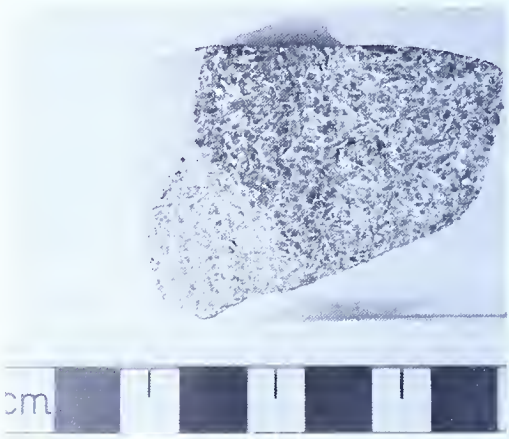

Photo 1

Photo 2

Unlike most barite, the McLain farm nodules give off a very strong odor when broken or rubbed against one another. To the author, the odor resembles carbide-generated, impure acetylene, but other staff members describe it as "sour hydrocarbon," "rotten egg" (implying hydrogen sulfide), or just plain "obnoxious" (implying mercaptans).

This is not the first report of fetid barite in Pennsylvania, as Genth (1875, p. 146) noted: "A fetid barite in brownish, radiating and columnar, ferruginous masses occurs at Heidelberg, Berks County;" and D'Invilliers (1883, p. 395) adds "also at Mt. Aetna, in Tulpehocken township." Mr. Jan Wise's father is said to have collected this type of barite a few miles east of the R. McLain farm.

Elsewhere in the Appalachians, Lawrence (1938) described dark, fetid, crystalline barite from the Fall Branch District, northeastern Tennessee. He reported that the area was underlain by thrust-faulted upper Knox Group dolomite (roughly equivalent to the lower Ordovician Beekmantown Group of Pennsylvania) and lower middle Ordovician Athens Formation shale. Lawrence (1938, p. 195) reported that ". . . stock piles exposed to summer sunshine had to be covered with canvas to protect the barite. If not so protected, it will disintegrate almost to a powder in a short time, and the decrepitation is so rapid that a crackling sound, like a light summer shower falling on dry leaves may be heard at a distance of several yards. The fetid odor is also given off during this decrepitation and is strongly noticeable at some distance."

Carpenter and Fagan (1969) also have described barite nodules from northeastern Tennessee and southwest Virginia which are very similar to the same two types of nodules from the R. McLain farm in Pennsylvania. Carpenter and Fagan found seven barite nodule occurrences in the basal 50 feet of the Athens Formation shale over a distance of 75 miles. Edmundson (1938) also has described the same type of black, fetid barite in Athens Formation shale from the Caldwell prospect, 15 miles north of Roanoke, Virginia. In agreement with Revelle and Emery (1951) who studied similar barite concretions off the coast of California, Carpenter and Fagan believed that this type of barite precipitates where highly saline, barium chloride-bearing hydrothermal solutions ascend into stagnant, sulfate-bearing marine sediments. Carpenter and Fagan relate barite mineralization in their area to associated zinc and lead mineralization and conclude that: 1) barium, zinc and lead mineralization may have occurred after Knox (Beekmantown equivalent) unconformity and that 2) barite nodules in shale may define an exploration target for zinc and lead in the underlying Knox Group carbonate rocks favorable for these latter metals.

The host rock on the McLain farm has been customarily referred to the middle Ordovician Martinsburg Formation, but associated rocks of this area have some characteristics not found in definite Martinsburg Formation appearing in normal stratigraphic sequence elsewhere. Some of the varietal lithologies have been established to be at least in part stratigraphically older than the Martinsburg Formation (Epstein, Epstein, and Bergstrom, 1972), and at least as old as some of the carbonate rocks inferred to underlie the shaly rocks of this area. Distinct thin limestone interbedded in the apparent barite host is believed to identify the host with the allocthonous (transported) rocks.

Because of the frequent association of barite with zinc and lead mineralization, the author collected a stream sediment sample to test for possible anomalous metals on the R. McLain farm. Considering the lithology of this area, the trace metal values are not anomalous (Rose and Keith, 1971) and do not suggest zinc or lead concentrations in the immediate vicinity. Exotic blocks of limestone now exposed within the Martinsburg are possible hosts for zinc or lead. The area from Berks County east to the Delaware River is favorable because of the facies change from limestone on the west to dolomite on the east within the Beekmantown Group beneath the middle Ordovician unconformity present in eastern Pennsylvania (Hobson, 1963). Some of this area already has been geochemically surveyed by Rose (1971), who found zinc anomalies in Martinsburg terrain NW of Allentown, Lehigh County.

There are other potentially important aspects of this barite. The observation of Carpenter and Fagan (1969) that the nodules are greatly restricted stratigraphically and present in a host rock slightly older than the Martinsburg Formation suggests that these easily mapped barite nodules might be possible stratigraphic markers in Berks and adjacent Lebanon Counties.

Barite itself has value. Barite is increasingly in demand for heavy drilling muds necessary for deep oil exploration.

Robert C. Smith, II

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U.S.G.S. open files land use maps

The U. S. Geological Survey has open filed land use maps and associated maps of southeast Pennsylvania. Land use maps at a scale of 1:250,000 (one inch equals approximately four miles) overlaid upon the standard 1:250,000 quadrangle maps (Newark, Wilmington, and Baltimore sheets) of southeast Pennsylvania have been released for Bucks, Montgomery, Chester and Delaware counties and the City of Philadelphia. In addition, 1:100,000 land use maps have been released for the same area. The 1:250,000 maps have been prepared from the Earth Resources Technology Satellite (ERTS-1) and show level one categories of urban, built-up, agriculture, forest land, water, non-forested wetland, and bare land areas. The 1:100,000 maps are high-level aerial photo mosaics, land use as of 1970, land use changes between 1970 and 1972, drainage basin maps, census tract and county boundary maps and cultural feature maps. The area of Pennsylvania is included in the Pottstown, Quakertown, Newtown, Burlington, Philadelphia and Coatesville 1:100,000 maps. All of these maps have been prepared by the Central Atlantic Region Ecological Test Site project (CARETS). This project is a jointly sponsored U.S.G.S.-NASA demonstration project to test the applicability of data from ERTS-1 and high-level photography. Copies of these maps are on file for viewing only at the U.S.G.S. Library, Room A-100, National Center, Reston, Virginia. Reproducible copies are on file at the U.S.G.S. Public Inquiries Office, GSA Building, 19th and F Streets, N.W., Washington, D.C. 20242. Reproductions can be obtained for the cost of reproduction through local reproduction companies. If additional information is required about these maps, contact the Office of the Chief Geographer, U.S.G.S. National Center, 115, Reston, Virginia 22092.

in the field ..... YESTERDAY

Believe it or not there are common-interest and sometimes just plain humorous incidents that happen in the course of doing geologic field work. These stories are never told in modern, scientific publications produced as a result of field work. However, at the time it happened each geologist is vitally involved.

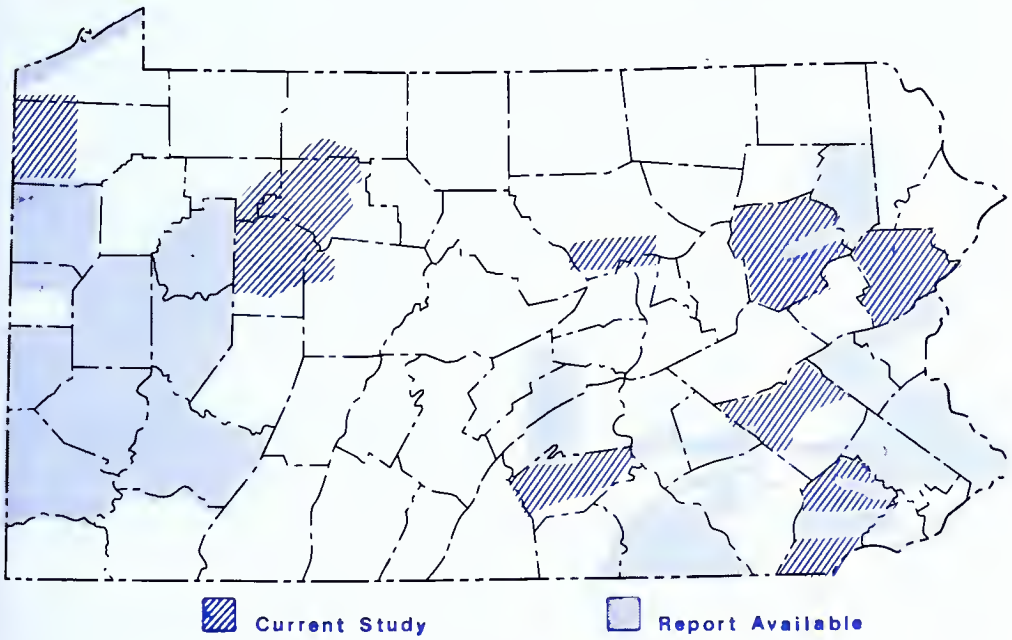
I recall one hot summer day working in the field with Carlyle Gray near Cornwall on the Lebanon quadrangle report (later to become the Survey's Atlas 167c). It was the summer of 1952 when we were alternating between mapping limestones near Cornwall with mapping the underground ore deposit at the Cornwall Iron Mine. This particular day we were mapping limestones near North Cornwall. As was the custom then, we carried our lunch and at noon picked a pleasant shady spot to eat it. That day a spot was chosen in a small grove of trees in open farmland just east of North Cornwall. We sat down and started eating and talking both geology and local affairs. As I recall Carlyle was sitting on a large fallen tree log and I on the ground. Sandwiches, a fresh tomato or two picked up along the way, and ice tea made up the lunch. A jug of ice tea, compliments of my mother, always seemed to accompany us each day that year. Shortly after we started eating, a full-grown adult skunk came out from the log Carlyle

was sitting on and nonchalantly walked past us and into a small burrow at the base of a stump. I don't know if he saw us or not but either way he didn't care and we, in turn, were very lucky. After recovering from momentary shock, I think we had a good laugh and continued mapping limestones.

Alan R. Geyer

A WELL DRILLER'S HIDDEN TOOL — THE GROUND-WATER REPORT

For many years the Pennsylvania Geological Survey has published reports on ground water in Pennsylvania prepared by the U. S. Geological Survey as part of a cooperative federal-state program. These reports have been used by geological and engineering consultants and planners for just as many years in decision-making processes involving water supplies. Some well drillers have also seen the value of these reports in improving their ability to select and/or evaluate well sites and, thus, enhance their competitive position while reducing costs, expanding business, and providing better customer service.



Areas of Pennsylvania covered by ground-water reports

For you drillers who are not aware of these reports or how they can be used for business purposes, the following thoughts may stimulate your interest in acquiring them.

Tables of data on wells and well water chemistry contain a wealth of information on well casing, and bedrock depths, water levels, rock types, yields, and water quality. Accompanying maps show the locations of these wells and the distribution of different rock units. From this basic information, you can get a good idea of what to expect of a well drilled at any site in the report area and adjacent areas that are underlain by the same rock units.

When you have predicted physical characteristics of a well, approximate costs can be determined and a reasonable price estimate or range can then be given to the customer along with a general description of the finished well, including pump size and depth setting.

From the text, other tables, and illustrations, you may obtain interpretive information that can provide a better site evaluation, awareness of potential drilling hazards, or the key to solving a customer's problem of water quantity or quality. Knowledge of potential hazards will enable you to anticipate problems which might otherwise drive costs above quoted prices. If potential problems exist, these can be discussed with the customer prior to drilling. Keeping the customer on your side in the face of adverse drilling situations is important to customer satisfaction. Detailed study of the reports frequently will enable you to understand how the ground-water system works in your area as well as how it fits into the complete hydrologic system and ultimately the environment of the area. The knowledge you have gained through experience when combined with that derived from reports can form the basis for excellent presentations to professional organizations, civic groups, and individuals in the area of your drilling activities.

A series of six regional reports are available for broad coverage of the entire state of Pennsylvania, as well as 10 individual county reports. Smaller areas are covered more intensively by additional reports. The index map shows areas of local studies completed and in progress. Information on areas of current studies is available, prior to publication of a report, from the U. S. Geological Survey personnel actively engaged in the study. A complete listing of all available ground water reports can be obtained by writing the Pennsylvania Geological Survey.

SURVEY ANNOUNCEMENTS

CORNWALL STUDY PUBLISHED

The world reknowned iron ore deposit at Cornwall, Pennsylvania, which began operation prior to the Revolutionary War, is described in great detail in the Pennsylvania Geological Survey's new report, "Geology and Origin of the Triassic Magnetite Deposit and Diabase at Cornwall, Pennsylvania," by Davis Lapham and Carlyle Gray.

The report is the culmination of years of intensive geologic mapping in the mines and detailed laboratory research. This result is one of the most comprehensive geologic reports ever issued on a Pennsylvania mineral occurence. Discussions include the stratigraphy and structure of Cornwall as they relate to the entire Triassic geologic basin, descriptions of the Cornwall ore bodies and their origin in relation to other Triassic area magnetite occurrences, and descriptions of the diabase and associated metamorphism. Many new concepts are put forth regarding origin of the ore deposit, structural deformation, geochemical alteration, and diabase petrology.

The importance of this report is not only as a scientific analysis of a unique ore deposit which has contributed heavily to Pennsylvania's history and economy, but also as a guide to exploration for additional iron ore deposits of the same type. The report will be of interest to the mining community, professional geologists, educators, planners, and historians.

Bulletin M 56, "Geology and origin of the Triassic Magnetite Deposit and Diabase at Cornwall, Pennsylvania," contains 343 pages, 23 plates, 58 figures, 38 tables, and three full-color maps. It is available for $9.35 (plus sales tax for Pa. residents) from the Pa. Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.

1973 OIL AND GAS DEVELOPMENTS RELEASED

The oil crisis and the related price increase has resulted in a marked increase in oil and gas exploration and drilling activity in Pennsylvania in 1973. A full report on those activities is contained in the new publication issued by the Pennsylvania Geological Survey, "Oil and Gas Developments in 1973," by William S. Lytle.

In 1973 the total of all wells drilled in Pennsylvania was 1099, up by 134 over the prior year. Of these wells, 99 were new exploratory and 1,000 were development. Venango and McKean Counties were the most active oil areas, with 205 and 126 new wells respectively. Indiana County was the most active gas area with 312 new wells.

The increased activity resulted in increases in oil reserves, gas production, and gas reserves. Oil production for the year was 3,282,000 barrels and gas production was at 78,514 million cubic feet.

These outstanding developments are detailed in Bulletin PR 187, containing 44 pages replete with maps, tables, and illustrations. This publication is available for $1.40 (plus sales tax for Pa. residents) from the Pa. Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.

SUBSURFACE SECTIONS ON OPEN FILE

Sepias of nine mechanical log cross sections of the subsurface rocks of Western Pa., Tully (M. Devonian) to Queenston (U. Ordovician), by Louis Heyman, and a location map of these sections will be placed on open file by the Pennsylvania Geological Survey with this announcement. The datum is the top of the Onondaga limestone and the vertical scale is 1 inch equals 100 feet. Only major correlation lines are shown on these sections. The final edition will include more detailed correlations, indications of lithology including location of salt beds, oil, gas and water shows, and an explanatory text; the final edition is expected to be available in 1975.

Blue line prints of these open file sections are available at cost of copying by applying to the Oil and Gas Geology Division, Pennsylvania Geological Survey, Department of Environmental Resources, 1201 Kossman Bldg., 100 Forbes Avenue, Pittsburgh 15222.

NEW OPEN FILE REPORT ON THE AGE OF PRECAMBRIAN ROCKS IN ERIE COUNTY

The Pennsylvania Geological Survey is placing on open file a 40-page report on *Interpretation of K-Ar and Rb-Sr Isotopic Dates from a Precambrian Basement Core, Erie County, Pennsylvania.*

A well drilled near Lake Erie in Pennsylvania penetrated Precambrian rocks at a depth of 5,952 feet. Rock samples from the well

were studied in an effort to describe the complex events which have affected basement rocks in this area. Included are petrographic descriptions, radiometric age dates, geologic description of the processes of rock evolution and the regional geologic setting. A 908 million year K/Ar age on the gneiss contrasts strongly with Rb/Sr ages of about 550 million years on gneiss and granite. The report is augmented by four illustrations and five tables of mineral compositions and age dates. It is available for examination in the Survey office, 419 Towne House Apartments, 660 Boas Street, Harrisburg.

NEW YORK SURVEY REPORT INCLUDES PART OF PENNSYLVANIA

Our sister Geologic Survey of New York has issued two new reports that include part of Pennsylvania. Map and Chart Series #14 by Nancy A. Wright, "Subsurface Tully Limestone in New York and Northern Pennsylvania," contains an isopach map, structure contour map and correlation sections indicating that the "Tully" limestone of Western Pennsylvania in reality is the Tichenor limestone.

Map and Chart Series #18 by L. V. Rickard is entitled "Stratigraphy and Structure of the Subsurface Cambrian and Ordovician Carbonates of New York." The report consists of 19 plates and text and gives information on correlation of stratigraphic units and wells as well as isopach and paleogeologic maps of the various major units. The "Northern Tier" counties of Pennsylvania are covered by this report.

Map and Chart Series #14 is $1.50, #18 is $5.00. Check or money order should be made payable to N.Y. State Education Department and mailed to Gifts and Exchange Section, N.Y. State Library, Albany, N.Y. 12224.

FIELD TRIP to a faulted syncline

Many excellent exposures may be seen along Interstate 81 in Pennsylvania. The most outstanding of these occurs at exit 39 about 5 miles southwest of Hazleton. Here Spring Mountain, a ridge trending ENE, has been cut through to provide passage for the highway (Figures 1 and 2).

Three major geological features may be observed at this outcropping. Overall, the road cut exposes a complete syncline with rock

Figure 1. View of faulted syncline from the south.

layers dipping gently south at the north end and gently north at the south end.

Secondly, this syncline has been disrupted by one major and several minor faults with the primary effect being that the south side of the syncline has been lifted, relative to the north side, by at least 50 feet and probably more.

Thirdly, the syncline exposes the contact of the Pottsville and and Mauch Chunk Formations marked by the change from reddish, brownish and gray shaly rock (Mauch Chunk) to lighter gray and brown sandstone and conglomerates (Pottsville). Both of the rock units are Mississippian in age and were deposited approximately 300 million years ago.

Several photographs were taken of this exposure during April 1974 and composited to show the details of the cut. A sketch was made of the important geologic features which are numbered on the sketch and discussed below.

(1) The prominent change from reddish shaly rocks to lighter grayish sandstones and conglomerates is the contact between the Mauch Chunk and Pottsville Formations.

(2) The prominent south dipping discontinuity is a reverse fault which has moved the south portion of the syncline upward and northeast over the northern part of the syncline. The relative sense of movement of the south block over the north block classifies this as a reverse fault.

(3) This south dipping discontinuity is a reverse fault also but apparently has moved the layers only a few feet.

(4) and (5) These two discontinuities appear to be faults that nearly parallel the layers of rock. Their apparent movement has been to move the upper rocks southward over the lower rocks or vice versa. It is impossible to determine how much movement occurred at these breaks. In addition, these discontinuities may be related to original discontinuities in deposition of the rocks. Many of the discontinuations and intersections of the layers of sandstones are apparently the result of "cross bedding," a type of layering at angles to other layering that is formed when coarse materials are deposited by rapidly moving water.

(6) The large rounded blocks of sandstone which are discontinuous and are surrounded by less coarse material may be pieces of sandstone that slumped from originally continuous layers and became surrounded by finer material.

(7) The vertical or near vertical fracturing that crosses the south dipping layers is a set of fractures called cleavage.

If you plan to visit this locality, extreme caution should be exercised. Traffic on the interstate is heavy and fast; the road curves at both ends of the cut so that oncoming vehicles cannot see all parts of the highway; the walls of the cut are very steep and subject to rock falls.

This is a unique geologic exposure which graphically illustrates a wide array of geologic features and processes. It is well worth a trip to see and study this outstanding feature.

This feature and other exposures along I 81 are also described in a free pamphlet, "Geologic Field Trip, I-81 from Harrisburg to Hazleton," available from the Pennsylvania Geological Survey.

Donald M. Hoskins

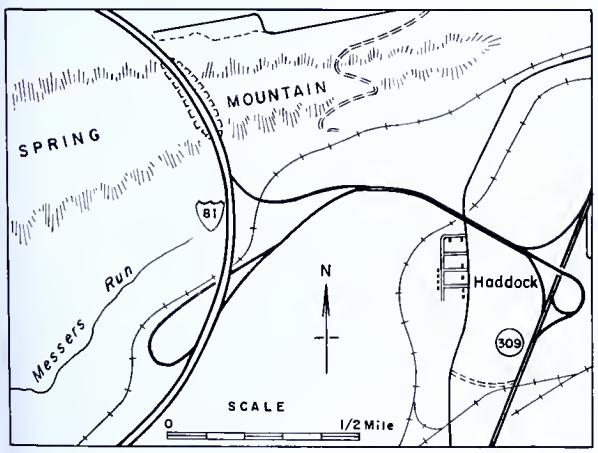


Figure 2. Location map.

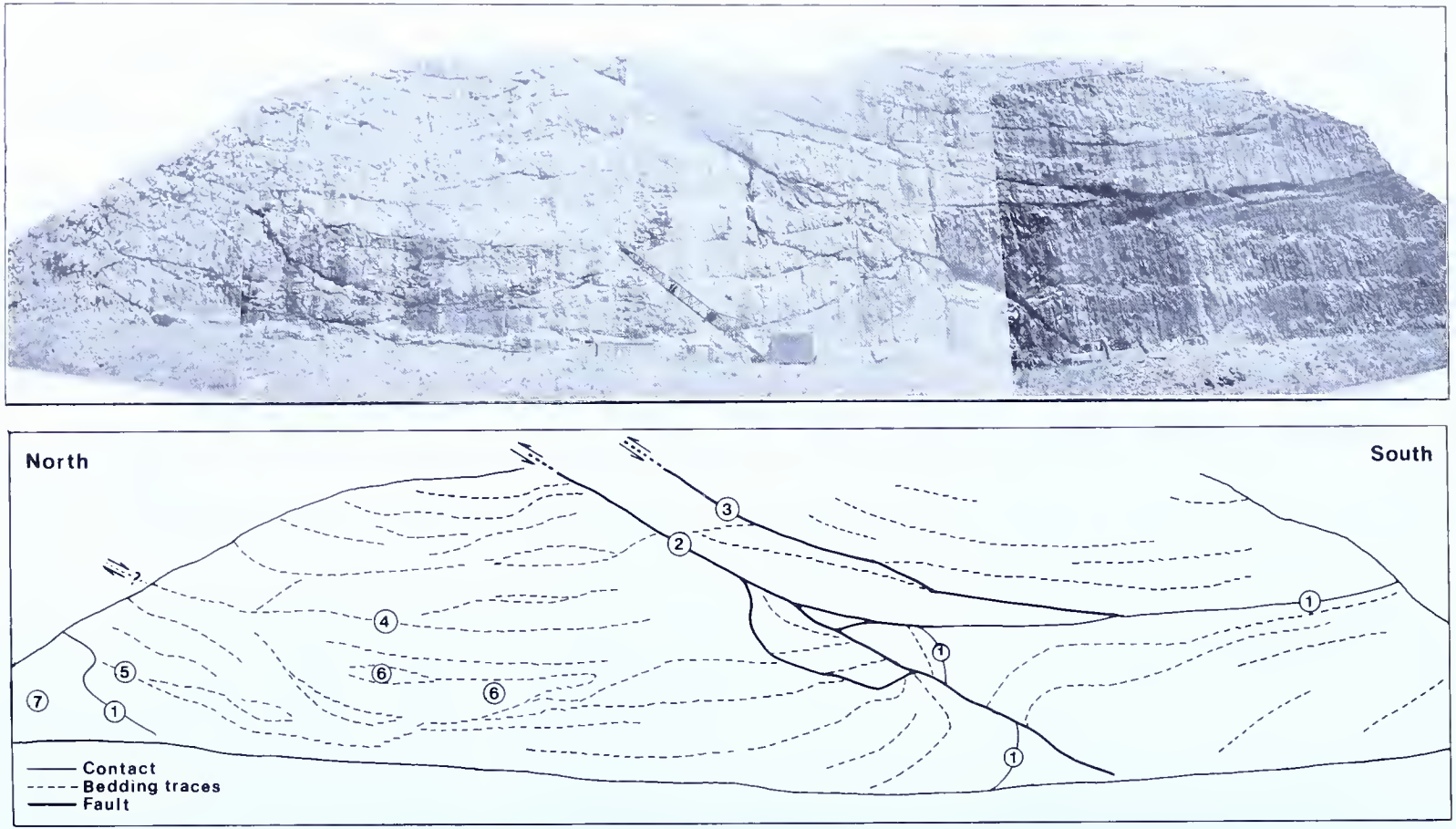


Figure 3. Composite photograph and explanatory sketch of roadcut.

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Stanwix Street, Pittsburgh, Pa. 15222

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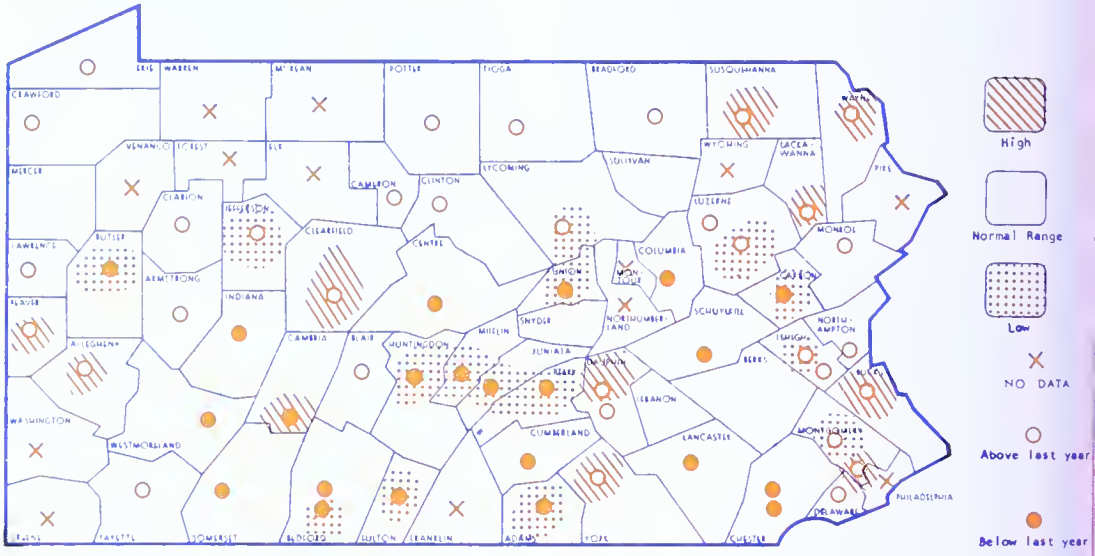
In Cooperation with The U.S. Geological Survey

GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

NOVEMBER 1974

GROUND-WATER LEVELS



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DEPT. OF ENVIRONMENTAL RESOURCES
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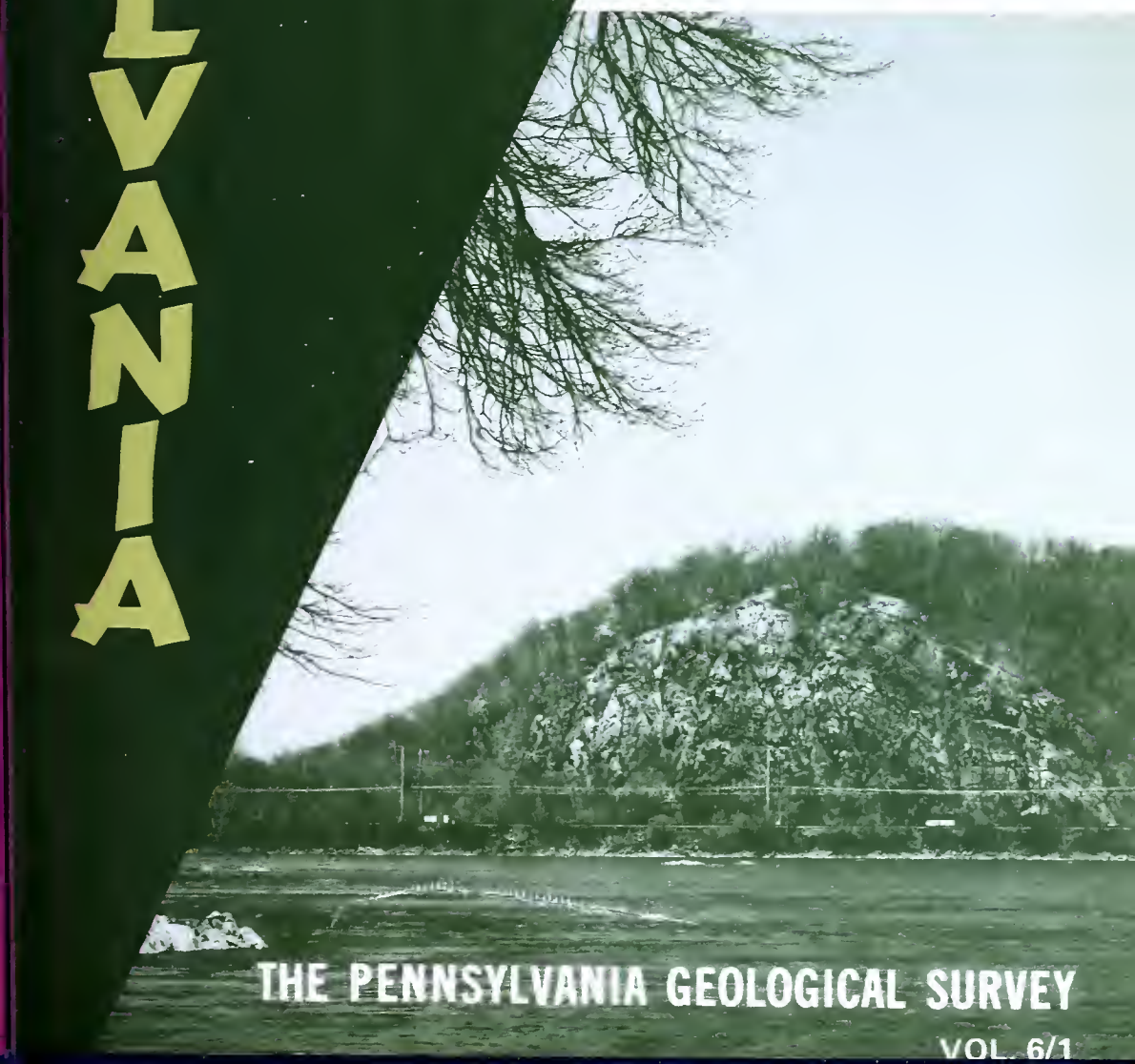
PENNSYLVANIA GEOLOGY



THE PENNSYLVANIA GEOLOGICAL SURVEY

VOL. 6/1

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: A scenic Lancaster County prominence along the Susquehanna River, Chickies Rock is an anticlinal structure of the Chickies quartzite formation. Photo courtesy of Grant Heilman, Lititz, Pa.

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FEBRUARY 1975

FROM THE DESK
OF THE
STATE GEOLOGIST

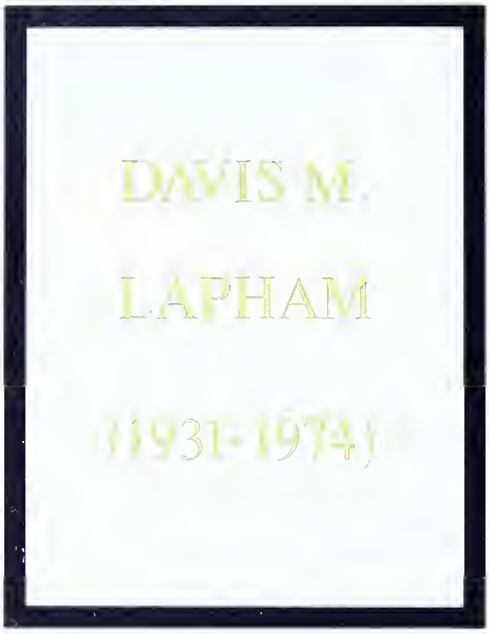
OUR STAKE IN THE ATLANTIC

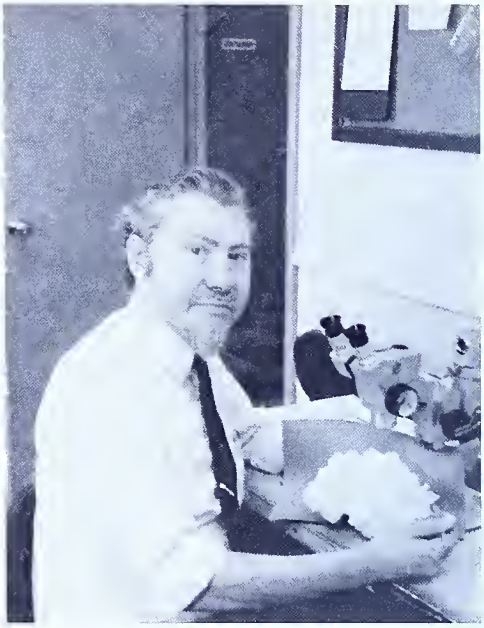
Pennsylvania has been participating in deliberations on the technical and environmental feasibility of developing oil and gas resources off the Atlantic Coast, an area referred to as the Outer Continental Shelf (called OCS for short). The Commonwealth has participated in public hearings held by the Interior Department and by the President's Council on Environmental Quality (CEQ) and this writer has served on the CEQ's Advisory Committee on drilling the OCS. The meetings have been open and all sides have been heard. The CEQ has conducted comprehensive studies of environmental impacts, including not only concerns over protecting the quality of the ocean, but also raising the question of economic and social impacts on the land if offshore production were to occur. It is in these latter categories that Pennsylvania has a direct stake in potential offshore production.

Should there be commercial quantities of oil and gas discovered and produced off the Atlantic Coast, (and this is still a big if, since there has been no drilling yet off the U.S. Atlantic Coast) any oil or gas which might be forthcoming would have to find a site on land where it could be processed. Inasmuch as the states directly along the seashore do not want to affect their resort environment, Pennsylvania, with its existing port and refinery capabilities along the Delaware River, could well be a recipient of much of any new offshore yields. With proper advance planning, such a development could be an economic asset to Pennsylvania and could raise the level of available energy resources.

It should be noted that in recognizing the potential benefits to Pennsylvania of offshore production, the Commonwealth has continually stressed that environmental protection and safeguards come first. Furthermore, I would note, that while preliminary geophysical data and geological interpretations suggest the existence of offshore conditions favorable to the existence of oil and gas accumulations, the actual occurrence of commercial quantities out there is at present a complete unknown; it is conceivable that it could be a flop. But it is also proper that there be exhaustive advance planning so as to be able to cope with all contingencies. To this, Pennsylvania is dedicated.

Arthur A. Socolow





Mineralogy has lost an outstanding scientist, the Pennsylvania Survey has lost an esteemed colleague, and mineral amateurs have lost a guiding spirit, in the death of Davis M. Lapham on December 20, 1974.

Davis became interested in minerals in 1949 as a high school student in Glens Falls, New York. While attending an adult education course in geology and mineralogy, he became fascinated with minerals. His teacher was the well-known collector, Elmer B. Rowley, whose personality sketch was written by Davis for the *Mineralogical Record* (Vol. 2, No. 1). After majoring in geology at Middlebury College, he went on to graduate work in mineralogy at Columbia University. There, working under Professors Paul Kerr and Ralph Holmes, he received his M.A. in 1955 and Ph.D. in 1957. In 1955 he was awarded the Kunz Memorial Prize by the New York Mineralogical Club for his paper, "Epidote from Hawleyville, Connecticut," later published in the *American Mineralogist* (Vol. 42, p. 62-72). This paper, based on his Master's studies, reveals the touch of a creative scientist. Not only were the descriptive data, geology, and mineral paragenesis given exhaustive treatment, but epidote itself was investigated in depth, using optical and X-ray techniques. As an outgrowth of his doctoral thesis on chromium chlorites, Davis developed his special interest in the chlorite and serpentine minerals. He came to be regarded as a top expert in their research; cores were sent to him from the Mohole deep-sea drilling project for the study of their serpentine minerals.

In 1957 he joined the Pennsylvania Geological Survey in Harrisburg to set up a mineral research division. From these laboratories came reports on the minerals of Pennsylvania, their occurrences, geochemistry and economic geology. Mineral amateurs and mineralogical education were not forgotten. Davis made many contributions through layman-oriented publications and through services provided to individual collectors. Perhaps recalling his days with Elmer Rowley, he particularly enjoyed aiding young, aspiring collectors. He did much to effect closer ties between professional and non-professional groups. Survey Bulletin G-33, "Mineral Collecting in Pennsylvania," co-authored with Alan R. Geyer, is a model of its kind, has gone through three editions, and continues undiminished in popularity.

Davis was the author or co-author of about fifty publications. Some of his most important scientific contributions have been: investigation of Pennsylvania's minerals and their occurrences; research on chlorites, serpentines and associated minerals and rocks of Lancaster County; geology and mineralogy of the Cornwall, Pennsylvania magnetite deposit; research elucidating the structural evolution and age of serpentinites in southeastern Pennsylvania. A recent major work, co-authored with Carlyle Gray, was Bulletin M-56 (1973) of the Pennsylvania Geological Survey, "Geology and Origin of the Triassic Magnetite Deposit and Diabase at Cornwall, Pennsylvania."

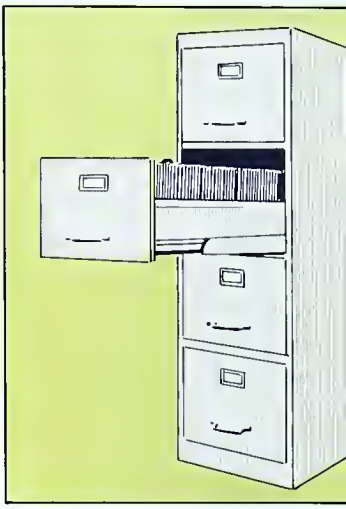
Davis was dedicated to the groups and goals of amateur mineralogy. He was a founding member of Friends of Mineralogy and was extremely active in its growth and organizational development. He was chiefly responsible for FM's locality-preservation program, and he was a guiding force in the vigorous, educationally-oriented activities carried on in Pennsylvania by FM Region 3. Davis was a fellow collector and friend of many in this group. But even more, his encouragement and aid reached out to mineral amateurs and their clubs everywhere.

None of this fully pictures the man. He was slight of build, modest, a courteous gentleman of highest intellectual and moral standards; with a keen wit and twinkle in his eye, he showed a warmth and regard for others that made him the friend of all. His interest in minerals was matched only by his love of music. He remained always a deeply-dedicated scientist, a perfectionist in every job he undertook, undeviating in his search for knowledge, understanding and truth. For many years he fought a quiet, valiant fight against diabetes, which sapped his strength and finally took his life. He never gave in to it, in work or outlook. To his wife, Nancy, his daughter, Heather and his parents, we express our sympathy and sorrow.

To mineralogy, the loss of his talents and creativity is great; to us who knew him personally as a co-worker and friend it is an even greater loss.

ARTHUR MONTGOMERY

NEW PROCEDURES FOR ACCESS TO SURVEY MATERIAL



The Bureau of Topographic and Geologic Survey produces a great variety of geological information. In some instances the procedures of formal publication involve the passage of considerable time; in other cases the nature of the data does not lend itself to publication. To make this information speedily available to the public, we have occasionally announced access to the information by classifying it "Open File" and have announced it in our bulletin, *Pennsylvania Geology*. We have had a great deal of call on this Open File information recently, taxing our staff's capability in handling these requests. We are therefore led to the necessity of establishing a more formal procedure of defining, releasing and handling Open File information.

Open File information will henceforth be publicly announced and will consist of two major categories: (1) reports and maps received or prepared by the Bureau and intended for eventual publication but which are delayed in publication due to lack of funds, backlog of manuscripts or partial completion of a project, and (2) files of information not intended for publication, such as water well, drilling or oil and gas well records and logs, oversize cross sections, detailed stratigraphic sections, and some manuscripts. Reports intended for publication will be reviewed and edited by the Bureau to conform to our current standards before being placed on Open File.

Open File information will be announced in our bulletin, *Pennsylvania Geology,* and an up-to-date listing of open file information will be available upon written request to our offices. This listing will give a brief title, where the information is reposited, whether it is reproducible, available on microfilm, or is available for in-office inspection only, and if reproducible or microfilmed, the cost.

Copies of a report or map that can be readily copied by our staff through Xerox or whiteprinting will be made available following the policy established by the Governor's Office and Department of Environmental Resources listed below:

Ten (10) (or less) 8½ x 11 pages (including microfilm aperture cards) are to be provided the public *free of charge*. More than the ten (10) pages or cards are to be charged for at the rate of

twenty-five cents (25¢) each, including the first ten (10) copies. For example:

10 copies of an original = no charge
11 copies of an original = $2.75

A fifty cent (50¢) charge per copy is to be made for maps (including any diagram larger than 8½ x 14) copied on Bureau equipment.

Some charts or maps, because of their size, must be reproduced by commercial copiers and their cost and mailing will be billed directly to the purchaser by the commercial firm.

Time for searching files exceeding one-half hour is to be charged for at the rate of $3.50 per hour.

U.S. Bureau of Mines Contracts for Synthoil Plant

(reprinted from Dec. 12, 1974 issue of COAL NEWS)

The Bureau of Mines has announced the signing of a contract with Foster-Wheeler Corp. to design a pilot plant to convert 8 tons of coal a day to about 1,000 gallons of low-sulfur oil, using the Bureau's Synthoil technology. The plant is to be erected at the Bureau's Energy Reserach Center in Bruceton, Pa., a suburb of Pittsburgh.

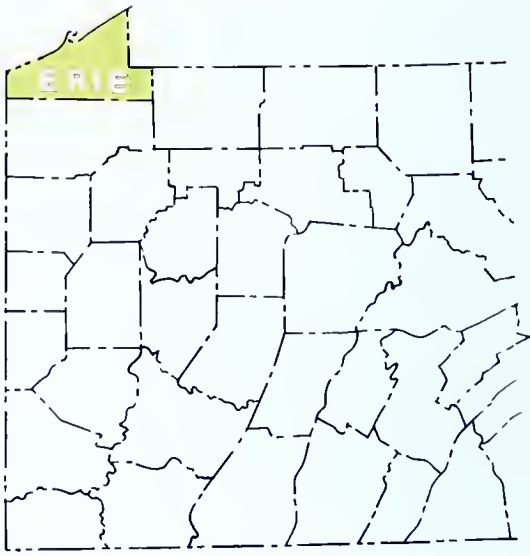
Under the $6,928,416 contract, Foster-Wheeler will also provide engineering services for the plant and be responsible for procuring about $4.5 million worth of equipment, which could cut as much as five months from the plant's lead time, the Bureau said.

The government expects to spend about $14 million on the Synthoil plant, $13 million of it coming from the Bureau and $1 million from the Office of Coal Research. By overlapping the design and construction phases of the plant, the Bureau hopes to start shakedown runs sometime in 1976.

In the Bureau's Synthoil process, hot pulverized coal is mixed with a "carrier" oil and brought into contact with a catalyst, under pressure and turbulent flow conditions, to produce more oil.

The Bureau said the pilot plant will be tested under a variety of operating conditions to obtain design data for demonstration plants and, ultimately, a commercial plant that might convert 20,000 to 30,000 tons of coal daily to 3 or 4 million gallons of Synthoil.

Erie County Study



The Water Resources Division of the U.S. Geological Survey in cooperation with the Pennsylvania Topographic and Geologic Survey, DER, is initiating a comprehensive hydrogeologic study of Erie County, Pennsylvania. The four-year project was initiated in January 1975 by G. R. Schiner and J. T. Gallaher whose office is in Meadville, Pa.

Competition for water is increasing in Erie County because of rapid industrial and population growth. The availability of fresh ground water is severely limited in much of the area because of the occurrence of saline water at relatively shallow depths. Accurate and up-to-date geologic and hydrologic information is needed to answer immediate ground-water problems and to supply data for long-range decisions on a county-wide basis.

Some of the expected products of the investigation are listed below:

1. Maps and a text that will indicate the areal extent, thickness, water-bearing and water-quality characteristics of the bedrock units and of the glacial deposits making up beach ridges, lake plain and valley fill.
2. Maps showing the locations of fracture traces, and an explanation of their relationship to well yields.
3. A map showing the depth to the salt water.
4. A study of wells near the shoreline of Lake Erie to determine if water from the lake is entering the wells.
5. Little geologic mapping has been done in the area since the 1880's; therefore, detailed geologic maps will be compiled. The maps will aid in the search for economic deposits such as gas and oil, glass sand, and aggregate material.

The results of the Erie County study will be made available to the public through publication by the Pennsylvania Topographic and Geologic Survey, DER.

Middle Devonian Fossils

AT SHADLE, SNYDER COUNTY, PENNSYLVANIA

Shales of the Mahantango Formation (Middle Devonian) in central and eastern Pennsylvania are well known for their abundant and diverse invertebrate faunas. Several excellent localities have previously been reported by Hoskins (1969), and other sites are undoubtedly familiar to "rockhounds" and professional geologists alike. The collecting locality described here is especially noteworthy in being one of the few places in Pennsylvania where relatively complete specimens of Devonian crinoids are known to occur. Other invertebrate fossils are also extremely abundant, particularly pelecypods and brachiopods. Most of the specimens occur as external and internal molds, although original shell material is preserved in hard, unweathered portions of the rock.

The locality is situated on the east side of the Mahantango Creek Valley northeast of the junction of Pa. Route 104 and L.R. 54010 in the village of Shadle, Snyder Co. (Fig. 1) (Lat. 40°42'15"N, Long. 76°59'24"W, Dalmatia 7½-minute Quad., Millersburg 15-minute Quad.). For the past several years, the landowner has been actively

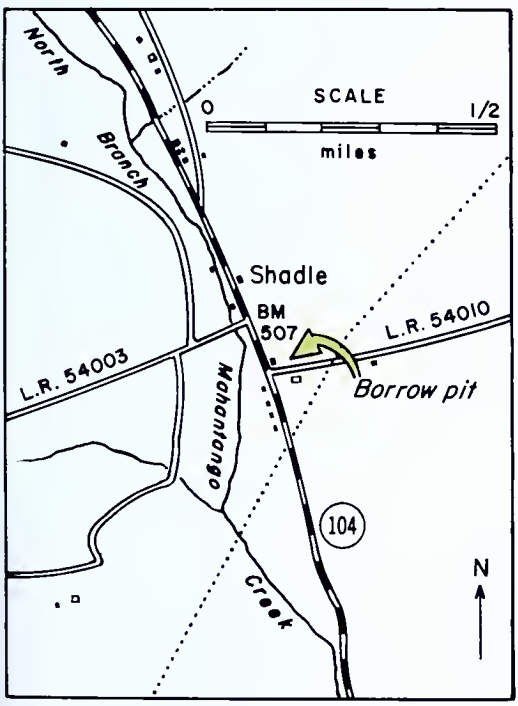


Figure 1. Location Map.

working a low ridge for borrow material and much fresh shale is continually being exposed. The best collecting is from the several large piles of rock that have been scraped up preparatory to shipment. Good material can also be found in outcropping ledges. Permission to collect should be obtained from the landowner, Mr. Marvin Haines, who resides on the property.

The beds exposed in the borrow area belong to the upper shaly unit of the Sherman Ridge Member, the uppermost member of the Mahantango Formation in central Pennsylvania. (Faill and Wells, in press; Faill and others, 1973). The predominant lithology is medium bedded, olive gray, intensely bioturbated, silty claystone that is dark gray and calcareous when unweathered. A few thin beds of fine-grained, planar bedded sandstone crop out in the upper part of the exposed section, but these are apparently barren of fossils. The most fossiliferous layers are siltstones that occur at two horizons separated by about 20 feet of less fossiliferous claystone. The lower horizon abounds in numerous species of pelecypods, brachiopods, and gastropods, whereas the upper is characterized by crinoids (both fragmented and complete) and a single brachiopod species, *Tropidoleptus carinatus* (Conrad).

The fauna of the Mahantango Formation at Shadle is extremely varied and includes bryozoans, brachiopods, gastropods, pelecypods, cephalopods, trilobites, crinoids (Fig. 2), and cricoconarids. The forms which have been identified and their relative abundance are listed below (a = abundant; c = common; unc = uncommon; r = rare):

Figure 2. Crinoid calyx from upper horizon at Shadle.

Bryozoans
- Unclassified (c)

Brachiopods
- *Tropidoleptus carinatus* (Conrad) (a)
- *Rhipidomella penelope* (Hall) (unc)
- *Protoleptostrophia perplana* (Conrad) (c)

Devonochonetes scitulus (Hall) (a)
Mucrospirifer mucronatus (Conrad) (a)
Mediospirifer audaculus (Conrad) (unc)

Gastropods
Ptomatis patulus (Hall) (r)
Bembexia sulcomarginata (Conrad) (r)

Pelecypods
Nuculites triqueter (Conrad) (c)
Palaeoneilo constricta (Conrad) (c)
Leiopteria sp. (c)
Modiomorpha concentrica (Conrad) (c)
Orthonota undulata (Conrad) (unc)
Grammysia arcuata (Conrad) (unc)

Cephalopods
Michelinoceras sp. (r)
Bactrites? aciculum (Hall) (c)

Trilobites
Trimerus (Dipleura) dekayi Green (c)
Greenops (Greenops) boothi var. *calliteles* (Green) (r)

Crinoids
Unclassified (calyces and columns) (c)

Cricoconarids
Tentaculites bellulus (Hall) (r)
T. attenuatus (Hall) (r)

Most of the species identified above are illustrated in Ellison (1965). Individual specimens from which the identifications were made have been deposited in the paleontologic reference collection of the Pennsylvania Geological Survey and are available for study. Systematic work on the crinoids is now in progress.

The upper Mahantango shales were deposited in a shallow, subtidal marine environment. Epifaunal and shallow infaunal filter-feeders and epifaunal deposit feeders dominate the fauna at Shadle, suggesting that the organisms lived in nutrient-rich, well-oxygenated waters. Periods of intermittent sedimentation and generally clear water apparently resulted in the proliferation of filter-feeding organisms (i.e., the two highly fossiliferous horizons previously noted), whereas periods of continual sedimentation were more hospitable to infaunal deposit feeders (i.e., the bioturbated claystone that characterizes much of the upper Mahantango).

The writer wishes to thank Misses Kathy Haines and Lesley Mull for providing numerous fossil specimens.

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Jon D. Inners

U.S. Geological Survey Issues New Maps

The U.S. Geological Survey recently published five geological, hydrological and miscellaneous maps covering parts of Pennsylvania. The geologic maps are 7½-minute quadrangle with all text and illustrations on the map sheet.

GQ-1132	Geologic map of the Nesquehoning Quadrangle, Carbon and Schuylkill Counties, Pa.
GQ-1133	Geologic map of the Tamaqua Quadrangle, Carbon and Schuylkill Counties, Pa.
HA-530	Floods of June 1972 in the Harrisburg area, Pa.
I-737	Geologic map of anthracite-bearing rocks in the southern half of the Delano Quadrangle, Schuylkill County, Pa.
MF-578-A	Map showing slate quarries and dumps in the Stroudsburg Quadrangle, Pa.-N.J. with a discussion of the environmental significance.

Each of these maps is available for $1.00 by writing to:

U.S. Geological Survey
1200 S. Eads Street
Arlington, Va. 22202

SURVEY ANNOUNCEMENTS

CONSTRUCTION RAW MATERIALS IN THE GREATER PITTSBURGH REGION

The nature and distribution of mineral raw materials which are essential to any type of construction is spelled out in detail in the Pennsylvania Geological Survey's new publication, Mineral Resources Report M 67, "Greater Pittsburgh Region Construction Aggregates," by Bernard J. O'Neill, Jr. The study was undertaken in response to the heavy demand for these materials in the Pittsburgh Metropolitan Area and the increasing shortages as the readily available material is being used up.

Sand and gravel, crushed stone, and slag constitute the major sources for construction aggregate in the Greater Pittsburgh region. The active producers of these materials are identified in the report and information on the geologic formation, physical test results, and current uses of aggregate from each operation is summarized.

Eight geological subdivisions with a potential for sand and gravel are plotted and discussed by origin, relative age, lithology, thickness, extent of weathering, and evaluated for construction aggregate. Areas where residential, industrial and/or recreational land-use conflicts exist are screened out.

The outcrop patterns for the Loyalhanna Formation and the Vanport Limestone—two important sources of crushed stone in the region—are plotted and isopachs showing the thickness of the Vanport are shown. Six other geological units supplying crushed stone and the availability of slags are also discussed. An evaluation of the potential for each unit is made.

The data presented in this report are designed to aid in locating: (1) areas with a demonstrated or apparent potential as sources of aggregate; and (2) active producers of aggregate. These data should be of particular value to the producers of aggregate who are facing predictable exhaustion of reserves, encroachment of other land uses,

or adverse zoning regulations. Consumers of aggregates will benefit from the information concerning active producers as well as the knowledge of future resources sites. This report will also be of interest and applied use to professional planners, Federal and State agencies, educational institutions, and all others interested in construction aggregates.

Bulletin M67, "Greater Pittsburgh Region Construction Aggregates," written by Bernard J. O'Neill, Jr., may be obtained from the Bureau of Publications, P.O. Box 1365, Harrisburg, Pennsylvania 17125, at $5.00 plus $0.30 sales tax for Pennsylvania residents; checks should be made payable to "Commonwealth of Pennsylvania."

SURPLUS TOPOGRAPHIC MAPS

As a result of the continuing revision program, we have a stock of surplus outdated 7½-minute topographic quadrangle maps. We are offering these maps at no charge, singly or in small quantities, to all interested parties.

When requesting maps indicate how many different quadrangles and the number of copies of each you desire; second and third choices should be indicated in case we run short. Contact: Dr. Arthur Socolow, State Geologist, Pennsylvania Geological Survey, Harrisburg, Pa. 17120.

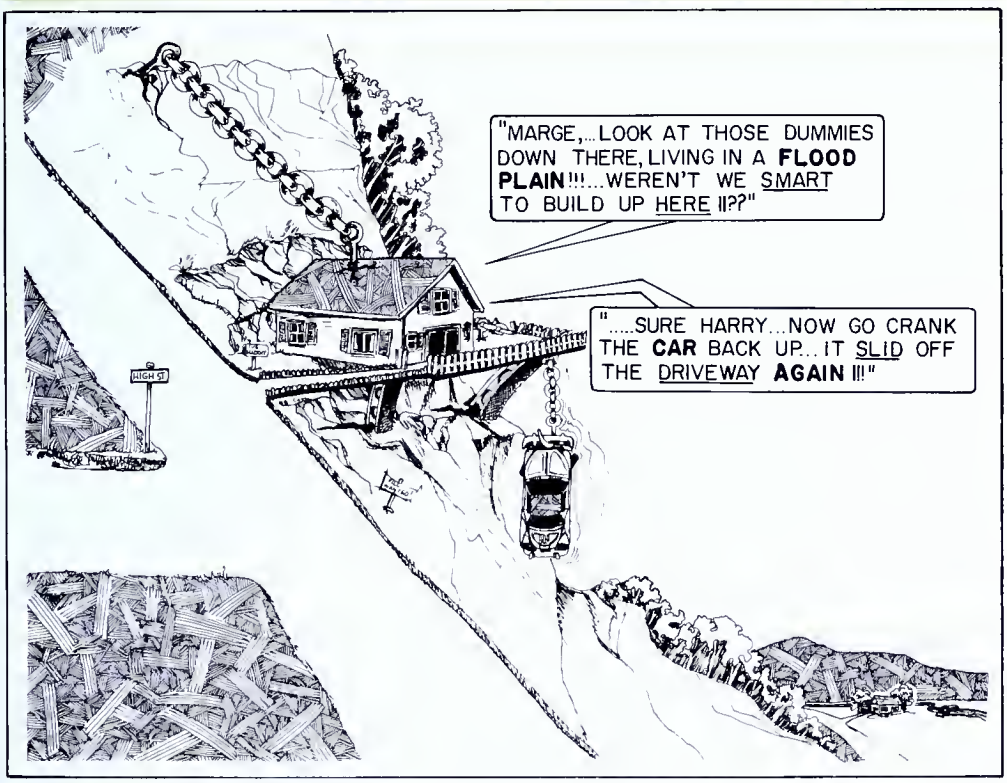
Abbottstown
Arendtsville
Bangor
Biglerville
Bushkill
Camden
Caledonia Park
Carlisle
Dawson
Dillsburg
East Greenville
Elderton
Ernst
Everett East
Everett West
Fairfield
Gettysburg
Greencastle
Hopewell
Hustontown
Iron Springs
Kennett Square
Lake Canadohta
McConnellsburg
Mercersburg
Mt. Holly Springs
Newfoundland
Quakertown
Saltillo
St. Thomas
Saxton
Scotland
Seven Valleys
Stahlstown
Waynesboro
Wells Tannery
Wertzville
West Grove
West York
Williamson
York

ERIE COUNTY BEACH RIDGES REPORTED

A detailed report on the nature and origin of beach ridges of Erie County, and of the glacial events which formed them, has been issued by the Pennsylvania Geological Survey as Bulletin G 64, Pleistocene Beach Ridges of Northwestern Pennsylvania, by Elizabeth E. Schooler. Based on field mapping and laboratory research, the study established the sequence of glacial events, the resulting development of the Great Lakes, and the composition and distribution of the resulting beach ridges. A detailed map and discussion of the surficial geology of the Harborcreek 7½-minute quadrangle of Erie County are also presented.

This report will be of interest and use to land use planners and engineers working in the area, to professional geologists and students concerned with the glacial history of northwestern Pennsylvania, and to the general reader interested in the explanation of features which form the present-day landscape.

Bulletin G 64 (38 pp., 14 fig., 2 large maps) is available for $2.95 (plus 18¢ sales tax) from Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.



Cartoon: Courtesy of the Washington County Planning Commission
Cartoon by Frank DeGennero

P.S. Geologists know there are alternatives to these extremes.

Interior Promotes Methane Recovery from Coalbeds

(reprinted from Dec. 12, 1974 issue of COAL NEWS)

Degasification of coalbeds before mining is a ready means of supplementing commercial supplies of natural gas as well as reducing the methane hazard to miners, Maurice Deul, a Bureau of Mines research supervisor, told the recent meeting of the Pennsylvania Governor's Energy Council.

He pointed out that since September, 1972, one billion cubic feet of methane—interchangeable with natural gas—has been drained from two experimental Bureau degasification sites.

"Because methane is an explosion hazard when released during underground coal mining, it must be swept out of the mine by constant ventilation," Mr. Deul said. "Instead of being released into the air and wasted; however, the methane could be drained from the coalbed in advance of mining, collected and used as a pipeline-quality fuel."

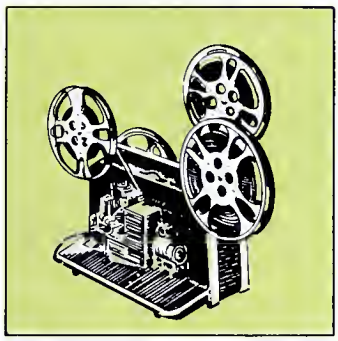
Bureau tests indicate that the Pittsburgh coalbed contains an estimated 130 billion cubic feet of methane, worth more than $65 million, under Washington County, Pa., alone, he said, and 350 billion cubic feet of the gas, worth more than $175 million, under Greene County, Pa. He added that if only half of the Washington County methane could be recovered, it would be enough to heat 100,000 homes for 10 years.

Secretary of the Interior Rogers C. B. Morton commended the Pennsylvania council for its interest in the methane-recovery technology. "We're extremely interested in getting coalbed degasification going on a large scale," he said.

The Bureau has pioneered two techniques for removing methane from coalbeds—one method, adapted from oil well technology, is "hydraulic fracturing" of the bed to promote gas flow, and the other is draining methane through bore-holes started from the surface. Methane from a Bureau bore-hole project in West Virginia is being distributed to residential and commercial consumers through connection with an existing gas pipeline.

EARTH SCIENCE TEACHERS' CORNER

new films



The following films were announced at the recent annual meeting of the Geological Society of America; charges (if any) should be obtained from the companies which issued the films.

THE CITY THAT WAITS TO DIE (57 min.). Presents the city of San Francisco, showing potential destruction and modern attempts to predict and control earthquakes. Time-Life Films, Inc. (TLF), Time-Life Building, New York, New York 10020.

THE BEACH, A RIVER OF SAND (20 min.). Investigates the source, movement, and ultimate fate of beach sand. Encyclopedia Britannica Education Corp. (EB), 1822 Pickwick Ave., Glenview, Ill. 60025.

APOLLO 17: ON THE SHOULDERS OF GIANTS (28 min.). Documentary account of the journey to Taurus-Littrow. NASA Regional Film Library.

THE DINOSAUR HUNTERS (50 min.). The badlands of Utah present the landscape for this film which describes the work of the vertebrate paleontologist. (TLF).

THE DRIFTING OF THE CONTINENTS (50 min.). Informative study of the revolution in geology which is turning the earth sciences upside down. (TLF).

ENERGY SOURCES FOR THE FUTURE (20 min.). A perceptive view of the most promising future power sources. AGI/EBE Earth Science Series.

ICE IN THE ATMOSPHERE (19 min.). Film explores the world of atmospheric ice, from birth and growth of crystals in clouds to hail. National Center for Atmospheric Research (NCAR), P.O. Box 1470, Boulder, Colorado 80303.

THE RAVAGED LAND (14.5 min.). Focuses on the problems of surface mining in the U.S. Shows efforts to reclaim surface mining areas in the U.S. and land utilization in England and Switzerland. John Wiley & Sons, Inc. (JW), Educational Services, Audio-Visual, 605 Third Ave., New York, New York 10016.

THE RIVER MUST LIVE (23 min.). A photographic essay of the causes, effects, and solutions of water pollution. Shell Film Library (SFL), 450 N. Meridian St., Indianapolis, Indiana 46204.

THIS LAND (41 min.). Dynamic presentation of the evolution of the North American continent. Excellent presentation through the use of paleogeographic maps and skillfully blended dioramas and modern landscapes. (SFL).

THE VIOLENT EARTH (52 min.). A view of modern plate theory and the view of a restless changing planet. National Geographic Society, Washington, D.C. 20036.

VOLCANOES: EXPLORING THE RESTLESS EARTH (18 min.). A study of four volcanoes that shows the features of volcanic areas and the effects of volcanic eruptions on man and his environment. (EB).

WASTE—THE PENALTY OF AFFLUENCE (18 min.). Displays how satisfactory disposal of waste is a problem which accompanies population growth; also shows how new technology of "waste" recovery and recycling of materials can result in feasible solutions. International Film Bureau, Inc. (IBF), 332 S. Michigan Ave., Chicago, Ill. 60604.

THE WAYS OF WATER (13 min.). A contemplative look at the natural behavior of water and its relationship to the total ecosystem. (EB).

DEEPEST WELL IN APPALACHIAN BASIN

The No. 1 Leonard Svetz well was completed December 31, 1974 at a total depth of 21,460 feet, the deepest well in the Appalachian Basin. The well was drilled in Middlecreek Township, Somerset County, Pa., and was spudded in on October 18, 1973. The well was a wildcat drilled by AMOCO Production Company with the Noble Drilling Company as rotary tools contractor. Some problems encountered made it necessary to plug back the hole to 8824 feet and sidetrack, plug back again to 9610 feet and sidetrack at 14,096 feet. It has now been plugged and abandoned. No data has been released on the well, but it probably reached the Gatesburg, Upper Cambrian, which was its target.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

Arthur A. Socolow, *State Geologist*
Donald M. Hoskins, *Assistant State Geologist*

TECHNICAL SERVICES

Shirley J. Barner, *Stenographer*
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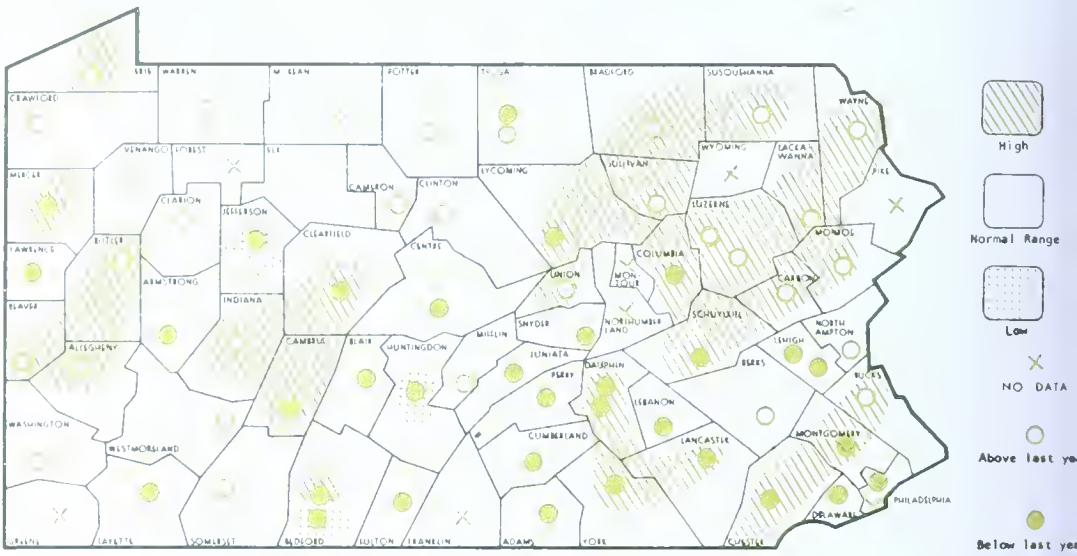
JANUARY 1975

GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120

CORRECT ADDRESS REQUEST

PENNSYLVANIA GEOLOGY

VOL. 6/2

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Executive House, new home of the Pennsylvania Geological Survey, Second and Chestnut Streets, Harrisburg.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

APRIL 1975

FROM THE DESK
OF THE
STATE GEOLOGIST...

THE SURVEY HAS A NEW HOME

The Pennsylvania Geological Survey has moved into new quarters. In case this has a familiar ring, you are right. This is the fourth location for the Survey in three years and while moving an entire Survey is a monumental task, we are becoming very proficient at it. Of course, two of the locations were temporary, post-flood sanctuaries. We are hopeful, however, that this time we are situated for a long and productive stay.

Our new home is shown on the cover photo. Unlike many geological organizations which are housed in basements or in rambling "ranch-type" quarters in the suburbs, our new home is a modern high-rise building in the center of the city of Harrisburg. Known as the Executive House, it is located at the corner of Second and Chestnut Streets, about six blocks from the State Capitol Building. While only one block from the river, this high ground was not flooded during the 1972 Agnes flood, nor do we anticipate that our quarters on the eighth and ninth floors are flood-prone. The administrative and staff offices are on the ninth floor, as are our totally refurbished and restocked library, map rooms, and photo files. The eighth floor carries our custom-designed laboratories, with all new equipment, including X-ray, chemical, petrographic, and darkroom facilities, as well as reference collections. Rock preparation equipment and core storage are amply provided in the basement.

Our quarters of some 24,000 square feet were designed for efficiency of operation and for effective service to the public. We would welcome visitors and anyone who has need for our library facilities; fortunately, there are ample parking facilities for visitors. The Pennsylvania Survey looks forward to many years of effective operations in its new home.

Arthur A. Socolow

USE OF UNDERGROUND SPACE IN GREATER KANSAS CITY

Excerpted from the December 1974 issue of Tunneling Technology of the National Academy of Sciences.

In Greater Kansas City some 2,000 employees work daily in factories, warehouses, and offices from 50–200 ft. below the surface. An extensive variety of uses have been developed for the subsurface, and mining techniques have been altered in anticipation of secondary use of the mined space. Today there is general public acceptance of underground utilization and development as an extra dimension of the city. Kansas City is a laboratory wherein an effective model of urban and mining compatibility has been achieved as well as the redemption of abandoned mines for a second and continuing use. Concepts of energy conservation through use of the insulating qualities of the rock have been incorporated into a full complement of cold-storage and freezer-storage warehouses. Urban space has been extended by expansion into a subsurface dimension. In Kansas City, use of subsurface space is no longer theory; it has been successfully practiced for nearly 20 years.

The rock in which underground development occurs in the Kansas City area is a Pennsylvanian massive limestone consistently 22–24 ft. thick, dipping imperceptibly underlying the northwest part of Missouri and extending into Kansas to the Oklahoma border. Room and pillar mining has been the general mode of operation, resulting in over 130,000,000 sq. ft. of mined-out space. The limestone is of commercial value mainly as aggregate for concrete and asphalt mix. The overlying shale and sealant clay have eliminated vadose groundwater erosion, so that karst features, such as caves, do not occur in this part of Missouri, leaving the shape and size of these rooms entirely at the discretion of man. All uses referred to are geologically separated from the surface by an undisturbed overburden of 50–200 ft. of additional limestone and shale. Today, we rationalize the use of the subsurface by citing such factors as the preservation of the

surface as esthetically valuable, being nondisruptive to existing neighborhoods, preserving a tax base, and many other reasonable benefits. However, in Kansas City it began simply as an economical source of space. Industry needed to expand, and the hills, with vast areas of mined-out space, were available. In the early 1950's, an overstock of cars was stored in an abandoned mine, and the concept of underground storage was born. Today almost 13 million sq. ft. of underground warehousing is in use in the Greater Kansas City area, with an additional 2 million sq. ft. of light and heavy industry and approximately 1 million sq. ft. of retail sales office, lounge, display areas, and miscellaneous uses. Regardless of our rationalization in behalf of the use of underground space, the Kansas City experience seems to indicate that it must be made economically feasible to gain wide acceptance.

One of the older mines in the Kansas City area, converted to warehousing.

Urban land can no longer be sacrificed to a single economic venture such as the removal of rock. The rock must be removed in such a manner as to leave the surface area available for future and continued usage. Where a mined-out subsurface exists, as in the Kansas City setting, both the surface and subsurface can be preserved for economic benefit to the community. A city is much more than a surficial adjunct superimposed upon the topography. Its development and growth are deeply rooted in the resources, benefits, and problems of its underlying geology.

The secondary use of mined-out space brings a reorientation of purpose in limestone mining. A new economic resource, the value of the mined space, now competes with the value of the rock, and attention is directed toward the dual objective of mining for the rock and for the later use of the created space. This places increased emphasis on the stability of the overburden as a surface for potential development above ground and as a ceiling to the development below ground. Some sites are impossible to convert to secondary usage due to the hazardous condition of the overburden, which was encumbered through mining methods not compatible to later use of the mined space. The irregularly spaced pillars, relics of the day when no thought was given to use of the mined space, are not adaptable to secondary-use layout. Quarry oeprators have therefore altered their methods of pillar spacing with the advent of secondary space use. Pillars are now 20–25 ft. square and regularly spaced 50–60 ft. apart on the center. This modification of mining practice in the Kansas City area has reduced income from rock extraction only slightly, but it has stabilized the surface area by virtually freeing it from danger of collapse. It has at the same time created a stable ceiling for the mined-out rooms, leaving them available for secondary usage.

Where limestone mining was once the primary use and the space left by mining only a byproduct, new uses for this space have proved a second and continuing role for mined areas. Low cost of underground space has enabled the warehousing capability of Kansas City to expand into its role of national leadership. Major secondary uses are warehousing, factories, and offices, in that order. One-seventh of Kansas City's warehousing is now underground. Eighty freight cars, each capable of holding 100,000 lbs of food, can be accommodated at one time on Inland Storage Distribution Center's two underground rail spurs, and many jobs are created by the receiving, handling, and redistribution of goods. The first underground freezer-storage room was developed in 1953, and Inland Storage Distribution Center leads as the world's largest refrigerated warehouse, handling 8 million lbs daily.

Amber Brunson was the first to quarry rock as a secondary process with his primary objective being to obtain the underground space for a factory. The underground factory was occupied in 1960, and his facilities have since been an object of national and international interest. The number of people in the 140,000 sq. ft. factory 77 ft. below ground ranges as high as 435. Precision settings are made at any hour in this vibration-free environment whereas only the low-traffic hours of 2:00–4:00 a.m. could be used for this purpose in a

Brunson Instrument Company, located 77 feet below the surface.

former surface location. One operation has an extensive two-tier development, with 44 acres of industrial park on the surface and a choice of either an elevator or a ramp entrance to an additional 28 acres of offices, industry, and warehousing over 100 ft. below ground in a former limestone mine. Additional mall shopping space is being created about 150 ft. below the surface at a cost slightly over half of comparable surface costs. Heating, air conditioning, maintenance, and security can be provided at a cost 60–70 percent less than a similar surface location. At a time when national attention is focused on energy conservation, it would seem that underground utilization that approaches an energy savings of 60–70 percent merits national acclaim. Capital outlay for extra equipment to handle temperature extremes is not required, because the temperature fluctuation in an underground site is less than 6° over the whole year. A lawn mower parts factory makes use of the high bearing capacity of the floors for its heavy industrial tooling and milling, and a sailboat factory utilizes the easily controlled humidity for setting its lacquers and glues. Printing shops take advantage of the controlled humidity for maintaining quality control.

Contrary to what may be expected, the underground rooms are easily kept dry with a minimum amount of dehumidification. Outside surface air does not rush into the subsurface, so that air once dried is easily and economically kept at whatever amount of humidity one desires. Metal machinery and factory equipment do not rust, and

metal parts may be stored without damage. The easily controlled humidity and the ease of establishing adequate security have made the underground facilities ideal for the storage of film and records. Company standby records for use in case of flood, storm, or fire, as well as bank and university microfilm, are increasingly being stored in underground vaults. In the Greater Kansas City area there are 28 sites that have usable subsurface space; 13 of these have developed some of their underground space for secondary usage, and there are 50–60 users of subsurface space occupying approximately 15,000,000 sq. ft. Analysis of the types of use made of underground space shows warehousing and storage as the principal use, making up 89 percent of the total; manufacturing accounts for an additional 7 percent, and offices and retail sales make up 4 percent.

by Dr. Truman Stauffer, Sr.

University of Missouri, Kansas City

GEOLOGICAL SOCIETY GUIDEBOOK OF PENNSYLVANIA FIELD TRIPS AVAILABLE

The Geological Society of America's enthusiastic and vivacious publications pusher Lee Swift has advised us that the Guidebook for Field Trips in Pennsylvania which was issued for the 1959 GSA meeting at Pittsburgh is still available. This excellent 203-page publication details the routes and geologic features for six field trips which were seen in conjunction with the geologic meetings. The field trips which are described are: (1) Structure and stratigraphy in central Pennsylvania and the anthracite region; (2) The Pennsylvanian of western Pennsylvania; (3) Monongahela Series, Pennsylvanian System, and Washington and Green Series, Permian System of the Appalachian Basin; (4) Mineral deposits of eastern Pennsylvania; (5) Glacial geology of northwestern Pennsylvania; (6) Engineering geology of the Pittsburgh area.

This 1959 Field Trip Guidebook is available for $2.50 from Publication Sales, Geological Society of America, 3300 Penrose Place, Boulder, Colorado 80301. Postage and a handling charge will be added where payment is not included with order.

The Lower Devonian Echinoderm *Anomolocystites* in Pennsylvania

Over the past few years, the staff of the North Museum of Franklin and Marshall College, Lancaster, Pennsylvania, in cooperation with the Pennsylvania State Historical Commission, has been assembling a collection of Lower Devonian fossils from Centre County, Pennsylvania. A large and varied collection of marine invertebrates has been found in the sandstones of the Old Port Formation, including brachiopods, trilobites, ostracods and assorted other animals and plants. At least forty species of animals have been recorded from this formation to date. Included in this fauna are carpoid echinoderms. These animals are among the rarest fossils found in Lower Paleozoic marine rocks. Thus, this discovery of a number of well preserved carpoids is noteworthy.

Echinoderms, animals such as sand dollars, starfish and crinoids, generally exhibit a striking five-fold symmetry. Calcite plates usually covered the body. Although echinoderms do not have a differentiated head or a distinct brain, they are classified as an advanced invertebrate group because their young closely resemble young chordates. At any rate, carpoids are primitive extinct echinoderms that are fundamentally asymmetric, that is, they lack the characteristic five-fold symmetry. A second distinctive feature of carpoids is their flattened body, reflecting a recumbent life style.

The Pennsylvania carpoids are advanced members of the carpoid echinoderm class Stylophora. The stylophoran carpoids had a flattened egg- or boot-shaped body with an anal opening at one end and a long flexible feeding arm attached to the other. The most advanced members of this group are named Anomolocystids. These peculiar animals first appeared in the Lower Silurian and apparently became extinct at the end of the Lower Devonian. They are found throughout the northern and portions of the southern hemispheres. The anomolocystids possess a number of features reflecting their adaption to a mobile way of life. These include secondary bilateral symmetry, a highly domed body, a long and flexible feeding arm, a large anal opening and a curious "pseudoimbricate" (or false overlapping) ornament on the upper surface that served to accumulate small food particles from passing currents.

Anomolocystites was first described by James Hall in 1861. At present this description of the genus and its two included species remains the best work available. Unfortunately, Hall's descriptions are inadequate for present needs, partially as a result of the poor quality of previously available specimens. This problem is magnified by the many conflicting uses of the name *Anomolocystites* by earlier paleontologists. Despite its obscurity, *Anomolocystites* has even been designated the type genus for an entire suborder of the fossil echinoderms! Thus the well preserved Pennsylvania material takes on special significance.

Prior to the Pennsylvania find, *Anomalocystites* was known from just two places in the world, central New York in the Manlius Formation and western Maryland in the Ridgeley Formation. Only subtle and inconsistent differences in the plate arrangements of the carpoids from each area distinguish them as separate species. The Pennsylvania form is identical to the Maryland species, *Anomalocystites disparilis*.

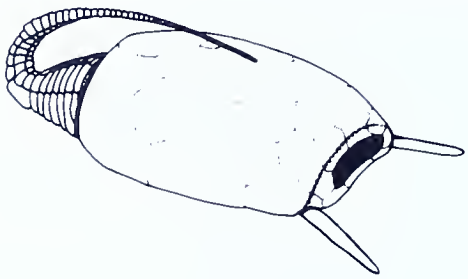
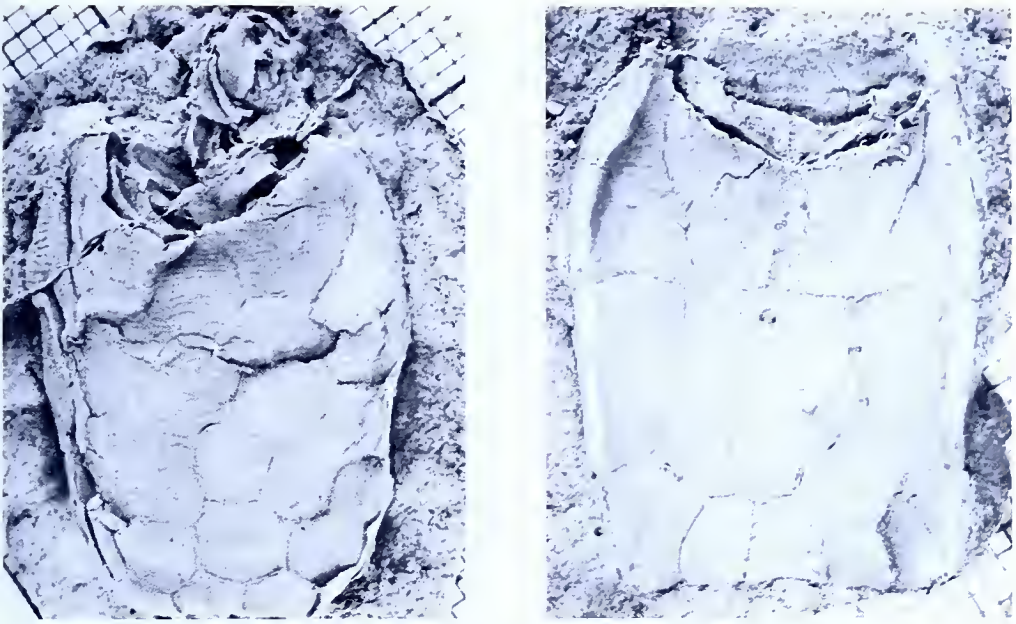


Figure 1 shows a sketch of the genus based on a detailed plate by plate reconstruction using all the known material. The results of this study are presently being prepared for publication.

Figure 1.
Reconstruction of *Anomalocystites* in Life-Position (x1)

Most of the material was found in the Old Port Formation (Upper Shriver) at Curtin, Pennsylvania. Here, the foundation of an old mill adjacent to the Bald Eagle Furnace was built out of sandstone blocks from the Old Port Formation. Hurricane Agnes destroyed the mill in 1972 and sandstone blocks litter the site. These blocks have yielded the carpoids, along with numerous trilobites and other fossils. Precisely where the fossiliferous blocks were quarried is not known, although they must have come from somewhere on the ridge immediately east of the mill site. The float locality at the mill is not available for collecting.



A B

Figure 2. Two Specimens of *Anomalocystites disparilis* from Pennsylvania: A) Lower Surface, B) Upper Surface (x2).

One additional carpoid was found *in situ* at an outcrop of the Shriver approximately fifteen miles northeast of Curtin, along the old Pennsylvania Route 220 adjacent to the Beech Creek Reservoir. Unfortunately, this outcrop is not available for collecting either.

Undoubtedly, there are many exposures of the Upper Shriver Trilobite Beds in Centre County and adjacent areas. Collecting at these localities should produce many fine specimens of both the carpoids and the associated trilobites.

Kraig L. Derstler, Geology Department,
Dr. John W. Price, Sr., North Museum,
Franklin and Marshall College,
Lancaster, Pennsylvania 17604

a barnful of mineral gems

This is the theme of the 12th biennial Earth Science and Gem Show of the Mineralogical Society of Pennsylvania to be held May 24th and 25th. The show will be at the Guernsey Show Barn on Route 30, at the intersection of Route 896, five miles east of Lancaster. The show opens 10 a.m. each day.

SURVEY ANNOUNCEMENTS

NEW MAPS OF PENNSYLVANIA'S COAL BEDS

The distribution and thickness of each of Pennsylvania's 13 major bituminous coal formations is presented in a set of 13 large, new maps just issued by the Pennsylvania Geologic Survey.

Responding to the energy crisis and the need to stimulate development of Pennsylvania's large coal resources, the Topographic and Geologic Survey conducted a crash program in the last year to assemble from all available sources the latest detailed information on the occurrence and limits of each of the 13 bituminous coal beds which have been mined in various sectors in western Pennsylvania. Data was collected from coal companies, from drilling records of oil and gas companies, from field mapping by the Geologic Survey's staff and from records of the U. S. Bureau of Mines and U. S. Geologic Survey.

The resulting coal maps, published at a scale of one inch to four miles, are color coded with contour lines to show the variations in known thickness of each coal bed and the known extent of each coal formation. This marks the first time that anyone has made this data available for all of the individual coal beds which have economic importance in Pennsylvania. This new set of maps also serves to supplement the data in the Survey's 1972 report entitled "Coal Reserves of Pennsylvania, Total, Recoverable and Strippable" (Information Circular 72).

The maps offer an important tool for planning the location of major coal consuming industries, such as generating plants and manufacturing establishments. The new coal maps will aid in refining the coal reserve calculations on an area-by-area basis, enabling priorities to be established for coal exploration and coal mine development, and will allow for advance land rehabilitation planning.

The new set of coal maps, compiled by staff geologists Mark Sholes and Viktoras Skema, is issued as the Geologic Survey's Mineral Resources Report M 68. It is available for $5.30 (plus sales tax) from the Bureau of Publications, Department of Property and Supplies, 10th and Market Streets, Harrisburg, PA 17125.

MINERAL COLLECTING BEING REVISED

By the time you read this, G-33, "Mineral Collecting in Pennsylvania", will no longer be available from the State book store. The present edition was written in 1969 and is now considerably out of date. Thus, the decision was made to completely revise it rather than reprint. The new, 4th Edition will miss the skillful input of Dave Lapham but his style, suggestions and additions will be used. Alan Geyer, Robert Smith and John Barnes will be the new writing team. The new edition will attempt to cover a wider variety of occurrences, include a more balanced geographic coverage, and list "fee" localities and localities where special permission is given only conditionally to selected groups.

Suggestions for deletions or additions to the list of Pennsylvania mineral collecting localities would be appreciated. Black and white as well as color photographs of Pennsylvania minerals are also needed. Please do not hesitate to send any ideas or materials to the authors in care of the Pennsylvania Survey. All correspondence will be quickly acknowledged and credit will be given for material used.

The authors hope to have the manuscript ready for review by mid-summer and the printed edition available by early 1976.

DUBOIS GEOLOGIC MAP ON OPEN FILE

The Pennsylvania Geological Survey is placing on open file the geologic map for the DuBois 15-minute quadrangle. Crop lines of the major coals in the area are shown along with structure contours on a particular coal. The scale of the map is one inch to 2,000 feet and the area includes the Hazen, Falls Creek, Reynoldsville and DuBois 7½-minute quadrangles.

Microfilm copies are available by writing to the Pennsylvania Geological Survey, Department of Environmental Resources, P.O. Box 2357, Harrisburg, Pa. 17120.

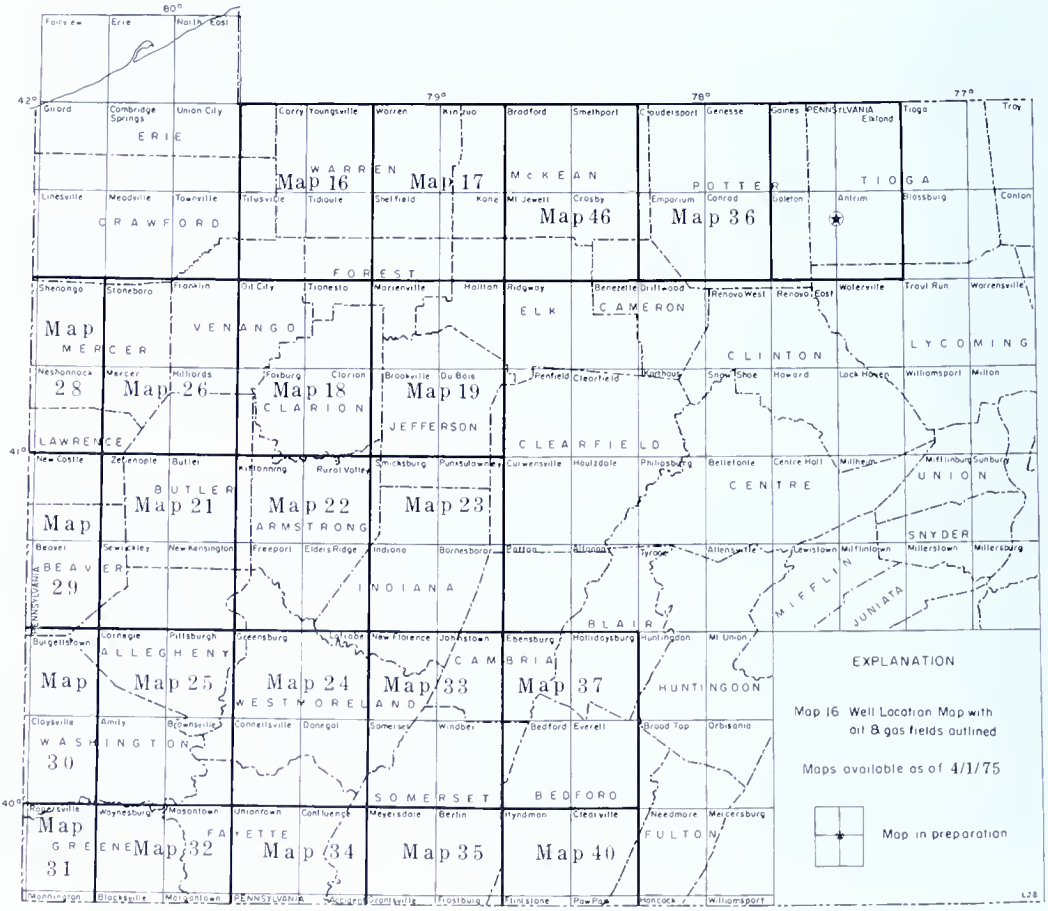
NEW OIL AND GAS BASE MAP AVAILABLE

A new oil and gas base map, #46, is now available and twenty-one previously available maps (updated as of June 1, 1974) are also available. Each base map encompasses four 15-minute topographic quadrangles and is at the scale of 1 inch equaling a mile and shows locations of oil and gas wells and the outlines of the oil and gas fields. Refer to index map. A five-minute grid, quadrangle names, county boundaries, and major rivers and towns make up the background of the base map. All deep wells known and all shallow wells on record with the Pennsylvania Geological Survey are located, and the status

(dry, oil producing, gas producing, etc.) is shown by symbol. Deep wells (Tully Formation or deeper) are differentiated and elevation and total depth are shown. Symbols indicate the availability of geophysical log and sample data on open file in the Survey's Oil and Gas Division office in Pittsburgh. An index map with the legend shows the outlines of oil and gas fields within the mapped area, thus indicating areas of extensive pre-1956 drilling. A listing of the field names is also included.

Paper prints of the base maps can be obtained by writing to the State Book Store, P. O. Box 1365, Harrisburg, Pennsylvania 17125. The cost of each base map is $0.50, plus a 6 percent sales tax to Pennsylvania residents. A check for the appropriate total amount made out to the Commonwealth of Pennsylvania must accompany the order. When ordering, please specify the map number.

A cross index of state permit numbers with quadrangle map numbers used on the base maps is available from the Pittsburgh Branch of the Pennsylvania Geological Survey, 1201 Kossman Building, Stanwix Street, Pittsburgh, Pa. 15222. This index is arranged by quadrangles. Please specify the quadrangle when requesting the literature.



Selenium in Eastern Pennsylvania,

A Benefit or Hazard?

Selenium is a rare chemical element (see table) in the earth, averaging about 0.1 ppm (parts per million) or less. However, for many samples selenium has been concentrated along with, and presumably by, organic matter (see table). Thus, although shales average about 0.6 ppm, a black shale rich in organic matter may contain up to 675 ppm (Lakin, 1972) and a soil with 44.5% organic matter has been reported that contained 1200 ppm selenium (Lakin, 1972). The selenium content of coal is known to be higher than for most other common rock types (see table), ranging from 3.74 ppm to 10.65 ppm for United States coals, with the highest concentrations in some Pennsylvania coals (Pillay and others, 1969). Finally, the rare mineral, native selenium, has been described from burning anthracite culm banks in eastern Pennsylvania (Barnes and Lapham, 1972). This

Figure 1. Anthracite culm bank at Forestville, Schuylkill County. Light area on bank indicates burning area where selenium occurs.

burning of coal in a reducing environment has resulted in locally high concentrations of native selenium—a concentration well above the statistically high amounts already present within organic coal deposits. The question, then, should be raised as to whether such high amounts are harmful, or beneficial, especially because it has been noted that the selenium content of the Susquehanna River (at Marietta) contains one of the higher dissolved selenium contents recorded for a river (see table; also Kharker and others, 1968, p. 290).

The question of the role of selenium in health is not a simple one to answer. Although selenium tends to follow sulfur in geochemical

Figure 2. Smoke and steam (sulfurous) from burning underground coal seam, south of Glen Lyon, Luzerne County.

behavior, its cycle from rock to soil to plant or water and to animal or human life is long and complex. It is tempting to correlate directly between the selenium content of the rocks of this area and a particular disease, but the correlations now known from one step to the next are few and may be subject to considerable modification both from geochemical and from medical considerations. A multiplicity of factors enter the problem. For example, the different solubilities of different selenium forms affect its ingestion by plants and animals. Certain plants will take up more selenium than others and, analagously, different organs and tissues in animals will concentrate selenium to different extents. The influences of other chemical constituents, of enzymes, of organic complexes, and of other factors such as human age or sex all may be significant contributors to a specific health problem so that the concentration of any one element may only appear to be causal. In actual fact, the role of that element may be only contributory or of no real effect. Thus, cause and effect relationships between disease and areal geochemistry are extremely difficult to evaluate.

In spite of this difficulty, however, some observations seem to be both correct and pertinent. As a result of the burning anthracite culm, native selenium forms on the culm surface. Some selenium probably has volatilized because selenium becomes volatile at a rather low heating temperature. Thus, some selenium will be transported directly in the air (e.g. as H_2Se) beyond the culm bank, becoming a part of the air pollution of the locality. Several facts are known regarding possible selenium pollution. First, elemental selenium is not a form that is readily available to plants (Oldefield, 1972, p. 175). Furthermore, the up-take of selenium by plants is inhibited by the presence of sulfur, which is abundant in the anthracite culm areas, by gypsum, which also occurs in these areas, and it becomes insoluble when bound to iron as the ferric selenite (Oldefield, 1972; Lakin, 1972). Further-

more, acidity favors complexes that make selenium unavailable to plants (Oldefield, 1972, p. 175). All of these factors will tend to reduce the amount of selenium in plants—amounts potentially available to foraging animals and ultimately to humans.

On the other hand, lime that may be used in fertilization or to neutralize the acid conditions present in parts of the anthracite area will enhance the up-take of selenium in plants (Oldefield, 1972, p. 173). In addition, where sufficient selenium is available, many plants will take up enough to result in possible harm to some animals in spite of the fact that plants differ in their ability to incorporate selenium (Lakin, 1972, p. 185). It is not known at the present time how much of the selenium in the anthracite area becomes available, i.e., in a soluble form, to the vegetation of the area. However, it might be assumed that the significantly increased selenium of the area could result in increased plant (and animal) selenium contents even if the abundance of soluble forms is rather low; that is, a concentration of selenium in the rocks that is many times the normal distribution may well yield more than normal amounts of soluble selenium. This selenium could then become available to animal, including human, life through plants and water.

Research then should be done to determine both total and available selenium in the areas of burning anthracite culm as well as in the areas of subsequent disposal after the burning culm is extinguished and redistributed. From a medical viewpoint, selenium has been referred to as a Dr. Jekyll and Mr. Hyde element (Lakin, 1972, p. 181). It can be both beneficial and detrimental. In the parts per billion range (ppb) of very small concentrations it is a dietary essential. A deficiency in selenium can cause weight loss, loss of animal hair, liver necrosis in mice, hepatosis in swine, myopathy in ruminants and poultry, and depress the growth rate of animals (Oldefield, 1972, p.

Figure 3. Black selenium crystals from Glen Lyon, Luzerne County. Large crystal is about 3/8" long.

174). Many such deficiencies are directly traceable to plants (Hedgerson and others, 1971, p. 59) and to deficiencies in the soil upon which they grow. In addition, selenium may protect against chromosome breakage and thus offer some protection against tumor growth (Hadjimarkos, 1973, p. 5).

On the other hand, in larger amounts that are in the ppm range, selenium toxicity is well documented. Selenium is suspected as a carcinogenic agent (Furst, 1971, p. 109), (Losee and Adkins, 1971, p. 207), (Burch and others, 1972, p. 45), (Laken, 1972, p. 186). Complex as the situation is, and even with insufficient medical and geochemical investigations, selenium in large quantities is believed capable of becoming a dangerous element.

What should be done? It has been shown that selenium, if present in an available form, can be toxic. It has been shown that statistically high levels of selenium are present in the anthracite area of Pennsylvania and in water that drains these areas. The next steps are to analyze the soils, vegetation, and animal life here to determine if selenium is concentrating and to what extent. Allied with this investigation should be a medical analysis of health statistics to determine if there is any correlation between selenium concentrations and health problems. If any such correlation exists, water and soil should be treated so that selenium becomes insoluble or is removed. The redistribution of extinguished culm should be carried out so that selenium-rich materials cannot readily enter our water supply. Locally grown vegetables and vegetation used by foraging animals should be carefully examined for selenium.

Conclusion: more information clearly is needed on selenium in parts of eastern Pennsylvania.

D. M. Lapham

Material	*Se (ppm)*	*Reference*
River Clays Adsorption	approx. 0.0001	Kharkov and others, 1968
Avg. 9 River Localities	0.0002	Kharkov and others, 1968
Susquehanna River, Marietta	0.000325	Kharkov and others, 1968
Soils, avg.	0.01	Vinogradov, 1959
Igneous Rocks avg.	0.05	Turekian and Wedepohl, 1961
Earth's Crust, avg.	0.09	Goldschmidt, 1954
Shales, avg.	0.6	Turekian and Wedepohl, 1961
U.S. Coals, range	3.74-10.65	Pillay and others, 1969
Black Shale, maximum	675.0	Lakin, 1972
Organic Soil, maximum	1200.0	Fleming, 1962

References cited available on request.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

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Robert C. Smith, *Geologist*

OIL AND GAS DIVISION

1201 Kossman Bldg.
100 Forbes Ave., Pittsburgh, Pa. 15222
William S. Lytle, *Division Chief*

Lajos Balogh, *Draftsman*
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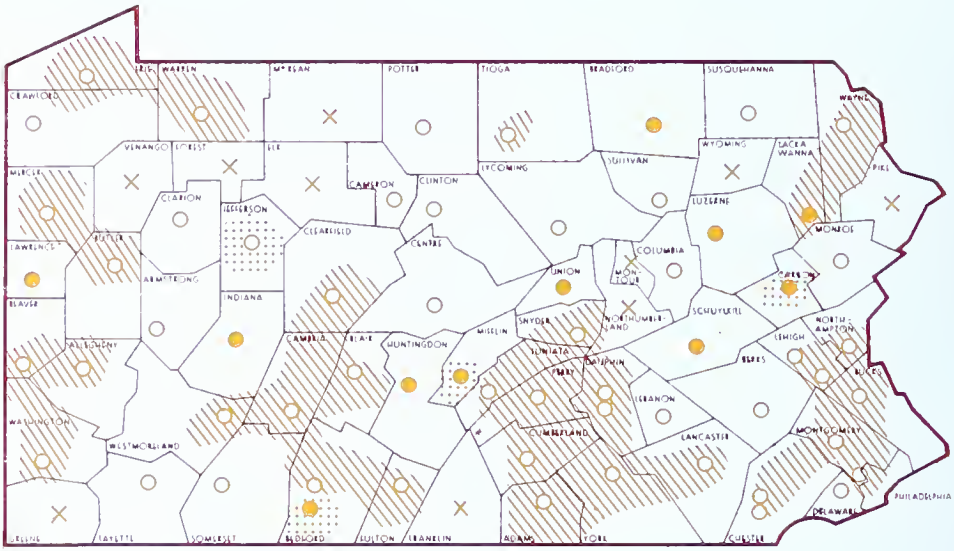
In Cooperation with The U.S. Geological Survey

GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

MARCH 1975

GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120

PENNSYLVANIA GEOLOGY

THE PENNSYLVANIA GEOLOGICAL SURVEY
VOL. 6

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Geology can be responsible for diverse land use. An area underlain by quality limestone is shown with two important land uses: (1) High grade farming of the prime soil on the limestone, and (2) Quarrying of the fine quality limestone for industrial and construction needs. While these two land uses may appear in conflict, each is vitally important to our economy. Photo courtesy of Grant Heilman, Lititz, Pa.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

JUNE 1975

FROM THE DESK
OF THE
STATE GEOLOGIST. . .

A GREAT COMMONWEALTH MINERAL DEPOSIT

The annals of economic geology include the geologic and production records of some of the great mineral deposits of the world. The long list would include such occurrences as the Butte copper deposit in Montana, the Sudbury nickel deposit in Canada, the Mesabi iron deposit of Minnesota, the Kimberly diamond deposit of Africa, the South African gold deposits, and the East Texas oil field. Unrecognized by many is the fact that Pennsylvania has a mineral deposit that must be included in any list of the world's great mineral concentrations: it is the anthracite deposit of northeast Pennsylvania.

With a production record of well over 5 billion tons since 1769, the Pennsylvania anthracite district has been one of the most valuable mineral concentrations on earth. Aside from the dollar value has been the fabulous socio-economic impact, for this was a major bulwark of the industrial revolution.

Yet the anthracite story is not just a historical record. Under 480 square miles touching parts of seven counties remains at least 16 billion tons of quality, low-sulfur anthracite coal, of which it is estimated that 6-8 billion tons are recoverable. With anthracite now bringing over $20 a ton at the mine, this recoverable volume of coal constitutes one of the world's truly valuable mineral concentrations. True, the remaining coal is deeper and more difficult to get at, but it is an established resource which, with proper environmental safeguards, can be of great benefit to our economy. Improved mining technology, co-ordinated large scale production, and innovative financing and marketing are needed to give new vitality to further development of our great anthracite resource.

We, therefore, applaud the interest of the Governor's Energy Council, and the Governor's Science Advisory Committee in searching for ways to stimulate increased anthracite production at this time when additional domestic energy sources are sorely needed. The Pennsylvania Geological Survey, in cooperation with the U.S. Geological Survey has done a great deal of work in the area but much detailed geologic work remains to be done. Collectively we hope we can make a significant contribution.

Arthur A. Socolow

Revision of State Geologic Map Under Way

In 1960, the Pennsylvania Geological Survey issued the fourth geological map of the Commonwealth of Pennsylvania. This map set a standard as one of the most detailed state geologic maps ever to appear; furthermore, its unique format and color rendition received commendations from far and wide. Previous geologic maps of Pennsylvania had been issued in 1858, 1893, and 1931; each newer map incorporated the geologic advances accomplished since the prior edition.

Since 1960, approximately one-quarter of the Commonwealth has been newly mapped or revised, and there has been considerable change and refinement in our understanding of stratigraphy and structure in Pennsylvania. These changes are the result of mapping by our own staff geologists, geologists of the U.S. Geological Survey, faculty and students at many colleges and universities, and geologists with the various mineral industries in Pennsylvania.

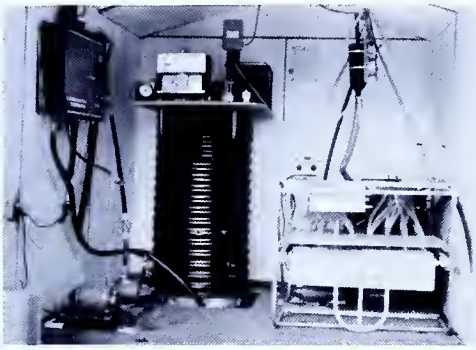
The time has come to draw all these geologic changes together on a new State Geologic Map. We have begun compilation of this fifth Pennsylvania map with an awareness that the present is a time of great urgency regarding geological matters. Our geologic environment, including our energy resources, rock and mineral resources, and groundwater resources must be managed with a wisdom that is based on sound and accurate geologic mapping. As Pennsylvanians address themselves to problems of the total environment, nothing is more basic than an awareness of the geologic environment on which we live, work, travel, and depend upon for our resources. Answers to many complex environmental problems in the Commonwealth hinge upon analyses of detailed information presented on a regional scale on a state geologic map. The new geologic map will be published at a scale of 1:250,000— the same scale as the 1960 edition. The base map will be extensively revised and updated and will include location of new highways, changes in drainage, and many other cultural changes.

The revision will be coordinated by Mr. T. M. Berg of our Geologic Mapping Division. We solicit your help in preparing this new map and would welcome your suggestions, data, and cooperation. Members of our geologic staff wish to make contact with any and all sources of new and revised geologic mapping in the state.

It is our intention to produce a new State Geologic Map as rapidly and as efficiently as possible, without sacrificing accuracy of detail or geological understanding. Our aim is again to produce a map which will receive acclaim for its exemplary standards.

CONTROLLING SEDIMENT

Techniques for controlling sediment from construction sites are the objectives of an investigation presently in progress by the U. S. Geological Survey, Environmental Studies Section, in cooperation with the Pennsylvania Departments of Transportation and Environmental Resources (State Conservation Commission). Sediment discharge is being measured below sections of Interstate 81 construction west of Harrisburg. In each of the construction sections, which are in separate watersheds, a different technique is being used to limit the amount of sediment discharge. Sediment discharge is measured by



Streamflow gaging and monitoring station showing from left to right, recording turbidimeter, stream stage recorders, and automatic streamflow sampler.

collecting samples of the streamflow from each of the watersheds using automatic equipment installed in gaging stations adjacent to the streams. The samples are analyzed for sediment concentration and sediment discharge is computed by relating the concentrations to recorded water discharges. Turbidity of the streamflow is also monitored by recording equipment installed in the gaging stations.

Large farm pond type structure placed on stream below the construction area to act as a sediment trap.

Soils in the construction area are derived from shale of the Martinsburg Formation. Most of the soils are shaly silt loams from 1 to 5 feet thick with low permeability. The low permeability and shallowness of the soils limits their agricultural potential. Before construction the area was an equal mixture of forests, active and abandoned farmland.

Methods used to control sediment discharge from the construction site included: (1) Frequent seeding of the exposed area as sections were completed or when operations were discontinued for a period. (2) Sediment ponds were excavated to intercept sediment laden runoff water from the construction area before it could enter the stream system. (3) A sediment basin (farm pond type structure) constructed on one stream below the construction area to trap sediment eroded from the construction area, as well as the normal sediment eroded from the watershed. (4) Structures were placed at the outlet end of several culverts to control outlet velocities and prevent scour.

Northbound section of Interstate 81 construction west of Harrisburg showing a stream crossing and established grass cover on the cut slopes.

AGNES' EFFECTS ON STREAMS

The December, 1974, issue of the U. S. Geological Survey Journal of Research carries a report on the research results of John H. Ritter on the effects of the hurricane Agnes flood on the channel geometry and sediment discharge of selected streams in the Susquehanna River basin of Pennsylvania. Surprisingly, in the 10 streams studied the width of the stream channels was changed very little by the flood and the stream beds were lowered (scoured) by less than a foot. Lowering of the stream beds did result in reduced stream velocities after the flood and reduced capability to carry stream sediment.

A new K-Ar date on the Masontown dike, southwestern Pennsylvania

by Pimentel, Nelly, Bikerman, Michael, and Flint, Norman K.†*

The Masontown dike is one of only two known igneous intrusions in southwestern Pennsylvania. The second one, at Dixonville in Indiana County, occurs in a now-abandoned coal mine (Honess and Graeber, 1926). The dike near Masontown is exposed in Middle Run, just north of the town of Gates in Fayette County (Fig. 1). The site is located in the Carimichaels 7½ minute quadrangle.

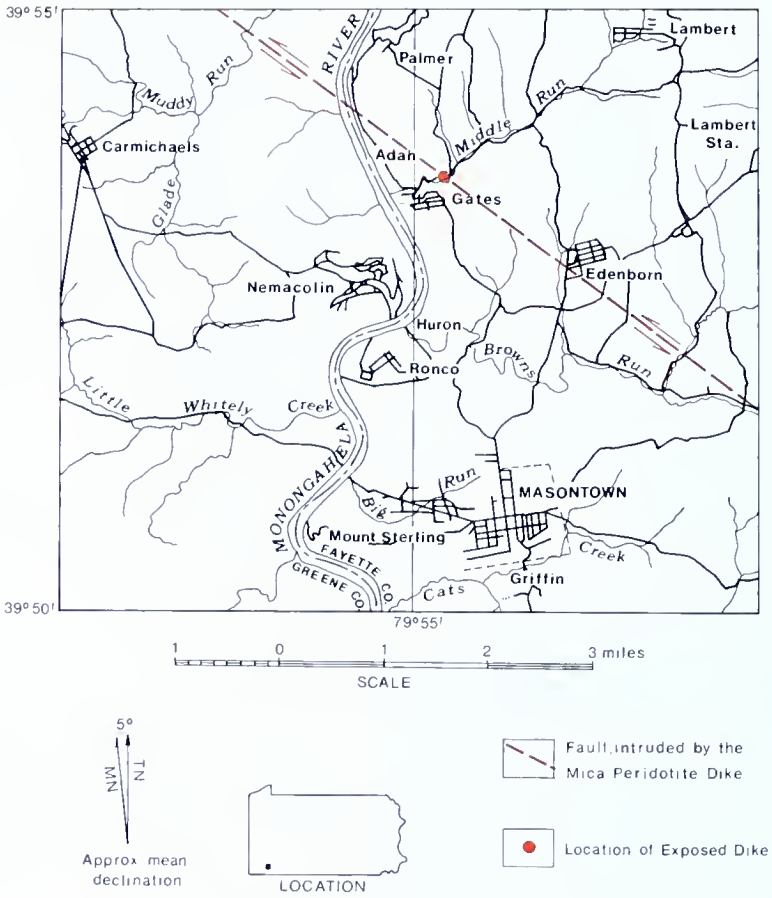
Previous studies (summarized briefly by Roen, 1968 and again by Pimentel, 1971) dealt primarily with the petrography and structure of the dike and its country rock. They indicate that the dike (actually a swarm of three or more small dikes, the thickest ranging from one to three feet across) is a mica peridotite, which intruded a pre-existing fault zone (Roen, 1968). The country rocks are uppermost Pennsylvanian and lowermost Permian (?) sediments of the Uniontown and Waynesburg formations, implying a post early Permian age for the dike. An earlier attempt to date the dike radiometrically (Zartman et al., 1967) ran into problems of excess argon, giving apparent ages of 368 ± 18 and 408 ± 20 m.y. on duplicate biotite samples. Equally variable and geologically excessive ages were found in similar peridotite dikes in New York by this group of investigators.

The University of Pittsburgh study (Pimentel, 1971) was undertaken to determine if a geologically reasonable K-Ar date could be gotten on a carefully selected and separated mica sample from the dike.

Procedure: The sample was collected from the thickest portion of the dike swarm on the northern bank of Middle Run (Fig. 2). On weathered surfaces it had a rough-textured, brown-colored appearance, and on breaking it open it appeared as a hard black rock with scattered mica phenocrysts.

Petrographic examination showed a porphyritic texture, with olivine, serpentine, phlogopite (mica), calcite, pyrope garnet and various black opaque minerals such as magnetite, perovskite, and ilmenite in a matrix of fine-grained calcite-dolomite (possibly secondary), serpentine, magnetite and other black opaques.

†Department of Earth and Planetary Sciences, University of Pittsburgh
Contribution No. 75-240 of the Dept.
*Now at: Ministerio de Minas e Hidrocarburos, Caracas, Venezuela.



Phlogopite was separated by conventional mineral separation techniques—magnetic, heavy liquids, and inclined shaking table followed by hand picking. Though the separations were done separately on several different sieve size fractions (20-40, 40-60, 60-80 and 80-100 mesh) all the sizes were mixed for the K-Ar analyses to provide sufficient sample.

Potassium was analyzed by atomic absorption (John Anania, analyst) in duplicate, and the value of 6.75% K is the average of two runs.

Argon was analyzed by isotope dilution using our A.E.I. MS-10 mass spectrometer and Ar^{38} spike from Zurich, prepared in a gas pipette system. The argon analyses were run in duplicate, one sample being baked overnight at 323°C prior to fusion (Run 1, Table 1) and the other being fused without baking (Run 2).

Results: The results of the K-Ar analyses are presented in Table 1. For purposes of discussion we can use the date 185 ± 10 m.y., weighing the results of Run #2 slightly higher because of a superior sample fusion. The difference may well be a real one as shown by the variances in argon contents in duplicate samples run by Zartman et al. (1967).

Discussion: If the apparent age of 185 ± 10 m.y. is a real emplacement time, it suggests that peridotite emplacement occurred not long after the basaltic activity in the Triassic Basins to the east (Armstrong and Besancon, 1970) and before the geologically reasonably dated (i.e., those without massive excess argon contents) dikes studied by Zartman et al. (1967). The possibility of excess argon in these phlogopites remains, however, and the true emplacement age may be younger.

The dike, which shows little contact metamorphism in its sedimentary country rock, must have been quite cool during its apparently passive intrusion at the rather high level above its magmatic source at which we observed it. This suggests that any excess argon contained in the phlogopite must have been "frozen in" at a lower, hotter, higher gas pressure level—probably in the primary magma chamber. A preliminary determination of strontium isotopic (Sr^{87}/Sr^{86}) ratios gave a measured whole rock value of .7050 ± .0006 (R. Methot, analyst) which when corrected for the Rb content of 450 ppm (Sr content was 640 ppm—both by X-ray fluorescence) and the K-Ar date, gives an initial Sr^{87}/Sr^{86} of about .700—or a source from a rubidium-poor region of the mantle.

Further work on the dike is in progress in our department. Comments from our colleagues are welcomed.

References cited are available upon request.

Table 1. K-Ar Dates on the Masontown Mica-Peridotite Dike.

Run #	*K Content*	*Ar^{40} Radiogenic*	*Ar^{40} Atmos.*	*Date (m.y.)*
1)	6.755%	$.217 \times 10^{-8}$ moles/gm	2%	175 ± 10
2)		$.238 \times 10^{-8}$ moles/gm	6%	188 ± 10

Constants used: $\lambda_e = .589 \times 10^{-10} y^{-1}$; $\lambda_b = 4.78 \times 10^{-10} y^{-1}$
$K^{40} = 1.21 \times 10^{-4}$ g/gK

Errors shown are based on laboratory experience on replicate samples.

FIELD CONFERENCE IN POCONO AREA

The annual Field Conference of Pennsylvania Geologists will examine glacial deposits and environmental geology of the Pocono area on October 3-4. The Pennsylvania Geological Survey will serve as hosts and guides. For anyone not on the conference mailing list, further details are available from Dr. Donald Hoskins, Pennsylvania Geological Survey.

News From the U.S. Geological Survey

U.S.G.S. Appoints Contact Man

Norman H. Beamer, District Chief of the Water Resources Division, U.S. Geological Survey, in Harrisburg, Pa., has recently been appointed Survey Representative in Pennsylvania by the Director of the U.S. Geological Survey.

The purpose of this appointment is to increase the Federal Survey's responsiveness to State needs and facilitate access to Survey products and expertise by State agencies and other Federal agencies active at the State level. The appointment will also provide, within the State, a designated, well-informed observer of State activities who can assist the Federal Survey in progressively orienting its programs to State requirements and in establishing effective working relationships with State agencies.

Mr. Beamer can be contacted at the office of the Water Resources Division, U.S. Geological Survey, Post Office Box 1107, 4th Floor, Federal Building, Harrisburg, Pa. 17108. His telephone number is (717) 782-3468.

U.S. Geological Survey Issues New Maps

The U. S. Geological Survey recently issued two maps covering Pennsylvania.

Hydrologic Unit Map—1974. State of Pennsylvania. $1.00

The hydrologic map shows regions, subregions, and accounting units which are divisions of the U. S. Water Resources Council Cataloging Units. The Regions and Subregions are used for comprehensive planning, including the National Assessment, and as a standard geographic framework for detailed water and related land-resources planning.

MF-620 Seismotectonic Map of the Eastern United States. $1.50

The seismotectonic map describes the distribution of historic seismic activity in relation to geologic structures and tectonic provinces. It identifies regions that are characterized by consistent relations between seismic activity and structural features.

Each map is available by writing to: U. S. Geological Survey, National Center—Mail Stop 950, 12201 Sunrise Valley Drive, Reston, Virginia 22092.

A NEW OCCURRENCE OF HIGH-CALCIUM LIMESTONE IN PENNSYLVANIA

Geologic mapping in a part of southeastern Pennsylvania has disclosed a previously unrecognized occurrence of high-calcium limestone that is believed to represent the economically important Annville Formation. Chemical analyses of composite samples collected from an exposure representing 90 stratigraphic feet of limestone indicate that the $CaCO_3$ content averages 96.94 percent, and the $MgCO_3$ content averages 1.24 percent. The potential reserves of high-calcium limestone within the mapped area, as roughly estimated, could exceed 30 million tons.

The Annville Formation is a commercially valuable high-calcium limestone that is being quarried at other localities for use as a source for lime and flux stone in the steel industry, for chemical lime, for agricultural lime, and to enrich cement mix. The demand for high-calcium limestone will increase significantly if the potential new market develops for its use in wet scrubbers to remove sulfur oxides from stack gases at power generating plants and at other industrial facilities that use coal.

The description of this new discovery is reported in Information Circular 76 by Bernard J. O'Neill, Jr. of the Pennsylvania Geological Survey. Copies of this publication will be placed on sale on August 5, 1975 for $1.50, plus 6% sales tax if the publication is to be mailed to a Pennsylvania address, from the following agency: Department of Property and Supplies, Bureau of Publications, 10th and Market Streets, P.O. Box 1365, Harrisburg, Pa. 17125.

On August 5 the publication will also be available for inspection at the office of the Director of the Pennsylvania Geological Survey, Room 914, Executive House, Second and Chestnut Streets, Harrisburg, Pennsylvania.

THORIUM-URANIUM OCCURRENCE IN HARDYSTON FORMATION

During field work for the new mineral collecting bulletin, a 24-inch thick radioactive (0.1 mR/hr.) zone was found at the base of the Lower Cambrian Hardyston Formation. Previously (*Pa. Geol.* vol. 5, no. 3), this mineralization was observed only in float. This location (latitude: 40°36'00"; longitude: 75°26'19") is a small, abandoned quarry along Constitution Drive 1200 feet east-northeast of the Allentown-Salisbury Township boundary. Qualitative X-ray fluorescence analysis of chips of the fossil placer indicate the following heavy metals: Major: Fe and Zr; Minor and Trace: Th, Y, Sr, Rb, Hf, and U.

Second Geological Survey Fossil Collection Curated

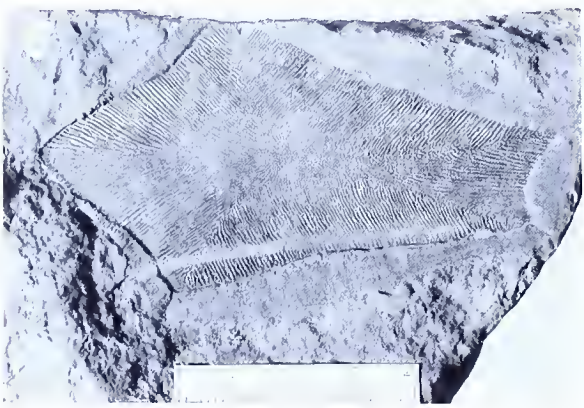
The Earth Science Section of the William Penn Memorial Museum has finished the curating of the fossil collections of the Second Geological Survey of Pennsylvania.

Under the direction of State Geologist Peter Lesley, the Second Survey (1874–1889) authorized various geologists to collect lithological and fossil specimens throughout Pennsylvania. Among the noted fossil collectors were F. A. Randall, John F. Carll, I. F. Mansfield, Leo Lesquereaux, E. W. Claypole, George B. Simpson and A. Sherwood. These paleontological specimens are catalogued in Second Survey volume 000. The collection has been housed in several Pennsylvania institutions during its history, but was most recently moved to the William Penn Memorial Museum from the Academy of Natural Sciences of Philadelphia in October, 1965.

Approximately 6200 fossil specimens have been cleaned, labeled, and put in catalogue order. They include large numbers of the representative invertebrate fossils of the state, as well as small plant and vertebrate (fish) collections. Of special note are the eurypterid collection of I. F. Mansfield (undescribed), and the Coal Flora collection of Leo Lesquereaux.

During cleaning of the collection a large thoracic plate of an arthrodire placoderm was found. This has proved to be Claypole's original (Type) *Plericthys? rugosus* specimen from the Chemung of Susquehanna County, Pennsylvania. Newberry later reclassified the specimen as *Holonema rugosus,* and we have labeled it WPMM V 12.

Emily B. Giffin
William Penn Memorial Museum



Median ventral plate of *Holonema rugosus* Claypole (Type). Scale in inches.

SURVEY ANNOUNCEMENTS

SURPLUS TOPOGRAPHIC MAPS

Because the U. S. Geological Survey has discontinued the 15' topographic map series (scale, 1 inch equals 1 mile), we have a surplus stock to offer to interested parties. We are offering these maps at no charge, singly or in small quantities.

When requesting maps indicate how many different quadrangles you desire and the number of each. Contact: Dr. Arthur Socolow, State Geologist, Pennsylvania Geological Survey, Harrisburg, Pennsylvania 17120.

Bedford
Blossburg
Cambridge Springs
Chambersburg
Mercersburg
Mt. Jewett
Powell
Rural Valley
Shippensburg
Wernersville
Windber

NEW LEHIGHTON-PALMERTON REPORT

One of the most comprehensive and detailed reports ever released on local area geology has been issued by the Pennsylvania Geological Survey as Atlas 195 cd, "Geology and Mineral Resources of the Lehighton and Palmerton Quadrangles, Carbon and . Northampton Counties, Pennsylvania." Co-authored by Jack Epstein, William Sevon, and Douglas Glaeser, this report describes the nature and distribution of the rock formations and unconsolidated surficial deposits within the 112 square mile area of eastern Pennsylvania that encompasses portions of the Great Valley, the Valley and Ridge, and the Pocono Plateau provinces. The rocks are a diverse assemblage of limestones, and conglomerates; the surficial deposits consist largely of sands and gravels of glacial origin. Each of these materials has its own characteristics which affect the way the land may be utilized by man.

Dealing with an area which is being subjected to continuing demands for wise land utilization, water supply and resource development, the information provided in this new report will be of value to planners, developers, water well drillers, industry, and all concerned with earth processes and resources of the area.

Atlas 195 cd, "Geology and Mineral Resources of the Lehighton-

Palmerton Quadrangles, Carbon and Northampton Counties, Pennsylvania," contains 460 pages, 175 figures, and four large full-color maps and plates. It is available for $24 (plus sales tax for Pennsylvania residents) from the Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.

MINERAL INDUSTRY STATISTICS AVAILABLE

Itemized data on the production volumes and values of Pennsylvania mineral commodities are contained in the Pennsylvania Geological Survey's new report on "The Mineral Industry of Pennsylvania in 1972." This report is authored by Franklin Cooper and is the result of a cooperative program with the U.S. Bureau of Mines. Pennsylvania is yielding over $1.2 billion worth of raw minerals per year, making us the largest mineral producing state east of the Mississippi River.

The new report presents data showing that Pennsylvania's leading mineral commodity by a wide margin is coal, with an annual dollar value of $780 million. The other major mineral commodities in order of importance are cement, limestone, sand and gravel, natural gas, petroleum, and clays. It is thus noteworthy that while not producing glamour minerals (such as gold, uranium, nickel, etc.), Pennsylvania's great mineral contribution is in the area of industry and construction minerals which are the true backbone of the nation's energy.

The new report on mineral industry provides a great variety of information on a commodity-by-commodity basis, as well as on a county-by-county basis. Major new developments are enumerated and the major producers of the various mineral commodities are listed.

Information Circular 78, "The Mineral Industry of Pennsylvania in 1972," is available at no charge from the Pennsylvania Geologic Survey, Department of Environmental Resources, Harrisburg, Pa. 17120.

NATIONAL SCIENCE FOUNDATION FUNDS SURVEY PROJECT

The Pennsylvania Geological Survey has been awarded a grant by the National Science Foundation under the RANN program (Research Applied to National Needs). This project is to demonstrate the application of environmental geology to rural and urban needs. The project work is intended to be completed in approximately six months, commencing June 2.

The project will be conducted in the Oil City quadrangle of Venango County by geology professors and students of Allegheny College, Edinboro State College, and Slippery Rock State College working under the direction of the Survey staff. The project director is Jesse L. Craft of our Environmental Geology Division.

The objectives of the project are: (1) to map and compile basic environmental geological data for the Oil City quadrangle; (2) to generate interpretive environmental maps from the assembled basic data; (3) to prepare manuals to demonstrate how environmental geological information may be used by informed lay people who serve in decision-making capacities in rural-urban jurisdictions.

NEW GEOLOGIST IN OIL AND GAS DIVISION

Mr. Robert G. Piotrowski has joined the staff of the Pennsylvania Geological Survey; on May 1, 1975, he commenced work with the Survey's Oil and Gas Division at Pittsburgh. Bob comes to us from the Amoco Production Company at New Orleans where he has worked on the practical aspects of oil and gas exploration. He graduated cum laude in 1970 from the University of Dayton and received his master's degree in geology from Duke University in 1972. Bob grew up in Aliquippa in western Pennsylvania and we welcome him back to Pennsylvania for work on the oil and gas geology of the Commonwealth.

MILLERSTOWN AREA REPORT

"Geology and Mineral Resources of the Millerstown Quadrangle, Perry, Juniata, and Snyder Counties, Pennsylvania" is the title of a major new geologic report issued by the Bureau of Topographic and Geologic Survey. Authored by Rodger Faill and Richard Wells, this comprehensive report details the geology of the central Pennsylvania area and its impact on land use and man's activities.

The stratigraphic section describes the individual rock units and the characteristics by which they may be recognized. The geologic rock structures are analyzed as a key to understand the processes of mountain building and deformation of this geologically complex portion of the folded Appalachian Mountains. Recognizing the importance of present and future mineral resources, the report describes the economic geology of the area. Limestone for construction, shale for ceramic material, and silica rock are noted. The report deals directly with the influence of geology on the human environment in matters of surface and subsurface water, and the rock conditions which affect excavations and engineering design.

With its detailed, comprehensive coverage of geologic conditions, the report will be of benefit to land use planners, industry, agriculture, and all who have an interest in the surface and subsurface make-up of the Millerstown area. Bulletin A 136, "Geology and Mineral Resources of the Millerstown Quadrangle" contains 276 pages, 104 illustrations, and 6 large, color geologic amps and cross sections. It is available from the Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pa., for $23.00 (plus sales tax for Pennsylvania residents).

DISTRIBUTION OF GEOLOGISTS IN PENNSYLVANIA

by Reginald P. Briggs
U. S. Geological Survey

Directories issued in 1974 by the American Association of Petroleum Geologists, the American Institute of Professional Geologists, the Association of Engineering Geologists, and the Geological Society of America list 586 Pennsylvania geologists who are members of one or more of these organizations. The 586 are not all the geologists in Pennsylvania (almost half the geologists in the 200-member Pittsburgh Geological Society are not listed, for example), but they constitute a very large sample, and it is likely that their distribution closely parallels the general state-wide distribution of geologists.

Ranking of the individual 11 counties having most geologists strongly suggests that Allegheny County is the geological "capital" of the state (Table 1).

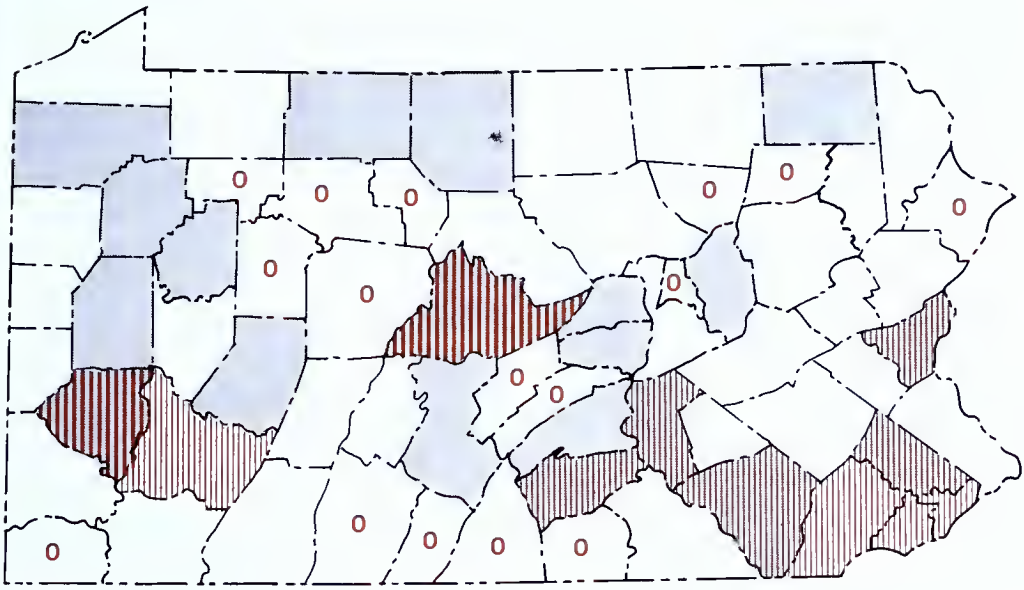
There is one listed geologist for about every 20,000 people in the state (586 listed geologists in total state population of 11,793,909—1970 census). It is interesting to note that only 7 of the 11 counties containing the most geologists have more than 1 per 20,000. On this basis a very different ranking results; rural Centre County (Penn State) is far in the lead (Table 1, right-hand column).

Some conclusions:

(1) Although there is some tendency for more geologists to be where there are more people, geological emphasis and opportunity seem to be more significant controls: in Allegheny County, the factor is chiefly resources; in Centre and in Northampton Counties, largely teaching; and in Dauphin County, chiefly government and services.

(2) The large isolated concentrations of geologists in Allegheny and Centre Counties are in contrast to the more diffuse distribution pattern in the southeast. This suggests that the central Pennsylvania mountains may be real barriers to extensive personal contact between most geologists in either Pittsburgh or Penn State and most other geologists.

Distribution of AAPG, AEG, AIPG, and GSA geologists in Pennsylvania, 1974



— counties with more than 50 listed geologists.

— counties with more than 10 but less than 50 listed geologists.

— counties having more than the Statewide average of 1 listed geologist per 20,000 population.

0 — counties without listed geologists.

Table 1. Pennsylvania Counties Having the Greatest Numbers of Listed Geologists in 1974.

Rank	*County*	*Number of Geologists*	*Number of Geologists per 20,000 Population*[1]
1	Allegheny	136	1.7
2	Centre	57	11.4
3	Northampton	45	4.2
4	Philadelphia	42	0.4
5 (tie)	Dauphin, Montgomery	39	3.5, 1.3
7	Cumberland	23	2.9
8	Lancaster	21	1.3
9	Westmoreland	12	0.6
10 (tie)	Chester, Delaware	11	0.8, 0.4

[1] On the basis of 1970 census.

MEET THE STAFF...

SAMUEL ROOT

Sam joined the staff of the Pennsylvania Geological Survey in 1963 and initiated a mapping program in the Great Valley and South Mountain of Franklin and Cumberland Counties which has allowed him to pursue his interest in structural, stratigraphic, and economic geology. He is currently mapping in the Harrisburg-Carlisle area, a rapidly expanding metropolitan area with attendant needs requiring considerable geologic information. In 1966 he assumed the duties of Chief of the Geologic Mapping Division, a group of 11 geologists engaged in a variety of mapping projects throughout the state.

A native of Winnipeg, Canada, Sam received B.Sc. Honors and M.Sc. geology degrees from the University of Manitoba and Ph.D. from The Ohio State University. As a student in Canada, during summers he mapped geology for various government organizations and mining companies in the gold mining districts of Manitoba, iron ranges of Labrador, and two summers in the southern Canadian Rockies. He spent a year as a geophysicist and well-site geologist in Alberta returning to graduate school and a career of field geology. At Ohio State he mapped the geology of a county as part of his dissertation. Joining Standard Oil of New Jersey after graduation, he was assigned to four years of geologic mapping in the Andes of Colombia and the Amazon Basin. Surviving this, he spent two years in geologic mapping and mineral exploration of the Peruvian Andes and Peruvian-Ecuadorian Coastal Basins. From here he came to Pennsylvania and except for a geologic excursion in the Swiss and Italian Alps with Penn State has confined his geologic activities to the Appalachians.

The Roots reside in Paxtang and their home and activities reflect their travels and cosmopolitan experience. Their daughter attends Boston University and their two sons are in high school and junior high. A member of various professional societies, Sam's geologic research has appeared in governmental publications, professional journals, and books.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

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Donald M. Hoskins, *Assistant State Geologist*

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Cheryl Cozart, *Stenographer*
Elizabath A. Eberst, *Typist*
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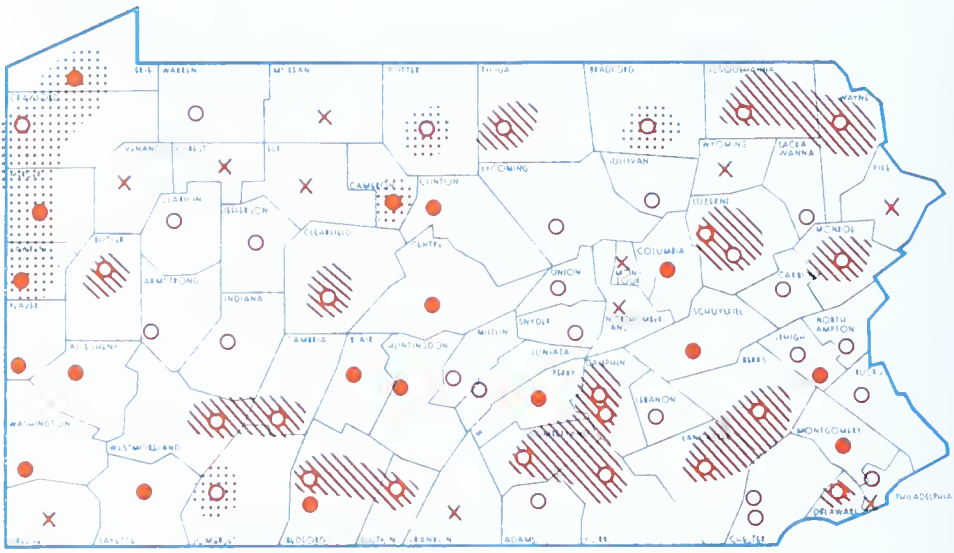
In Cooperation with The U.S. Geological Survey

GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

MAY 1975

GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120

CORRECT ADDRESS REQUEST

PENNSYLVANIA GEOLOGY

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Iron furnace at Greenwood Furnace State Park, Huntingdon County. Minerals have played a large role in Pennsylvania's bicentennial history. Photo by Mark Silverman.

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AUGUST 1975

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

WHY PENNSYLVANIA FOR URANIUM PROSPECTING

In the early and mid-1950s a considerable number of individuals and small companies searched through many parts of Pennsylvania for significant uranium occurrences. That interest was a spillover of the western uranium prospecting boom which had located so many major occurrences in Colorado and Utah. In 1957 the Pennsylvania Geological Survey undertook a study of known and potential uranium resources in Pennsylvania; the results were published as Bulletin M43, Uranium in Pennsylvania, by John McCauley. Of the 43 Pennsylvania occurrences reported at that time, only one was (for a short time) in commercial production as a source of uranium ore; at each occurrence either the ore grade was below economic limits or the indicated quantity of ore was inadequate. Yet today, in 1975, many major uranium producing companies, as well as the U.S. Geological Survey and the federal Energy Resources Development Administration, have geologists engaged in comprehensive exploration for uranium resources in Pennsylvania.

What has changed since 1957 to cause the present surge in Pennsylvania uranium prospecting? Basically, it is due to a recalculation of the nation's future need for uranium and a resulting sharp escalation in the price. In the 1960s the United States felt that its known uranium resources were adequate to fulfill its nuclear power plant needs. It was thought that by 1975 breeder reactors would begin to take over, thus reducing the need for uranium fuel. But the breeder reactor development has fallen far behind schedule and so conventional nuclear generating plants will have to continue to serve and be fueled through the 1980s. Thus, the realization that more uranium resources must be found resulted in a sharp rise in the price for the ore. Just a few years ago, uranium oxide was down to less than $7 a pound; today there are reports of as much as $30 a pound being contracted for 1980 delivery. It is small wonder then that those small, low grade uranium occurrences of Pennsylvania are being given serious attention by major uranium mining companies. New, sophisticated techniques are being utilized in prospecting for additional hidden, deep-seated uranium occurrences. Bold new theories of ore localization are being tested.

Need and price have stimulated uranium prospecting in Pennsylvania. The Pennsylvania Survey's earlier data are serving as a valuable starting base for the new exploration. It would not be at all surprising in the near future to hear of significant new discoveries in Pennsylvania.

Arthur A. Socolow

GEOLOGICAL RESEARCH IN PENNSYLVANIA 1975

INTRODUCTION

This publication is the eighteenth annual report on Geological Research and Publications in Pennsylvania. This is an attempt to list all current geologic research in Pennsylvania and includes persons and projects other than those of the Pennsylvania Geological Survey. Because of the extensive response and large number of projects reported to us, we have had to exercise editorial license to reduce the description of the research projects to fit our available space. We have also attempted to determine an anticipated completion date (ACD) for each project. The anticipated completion date is the estimate of the date when the author will complete his report; additional time for publication should be projected.

The listings are grouped into major categories of research to facilitate your search for information on a particular subject. Publications in press are listed by author.

As with all compilations, there may be omissions; this is unintentional. Additional copies of this report may be obtained by writing to the Bureau of Topographic and Geologic Survey, Department of Environmental Resources, Harrisburg, Pennsylvania 17120.

RESEARCH IN PROGRESS

AREAL GEOLOGY

T. M. BERG, W. D. SEVON, Pa. Geol. Survey, and M. F. BUCEK, The Pa. State Univ. Geology and Mineral Resources of the Pocono Pines-Mt. Pocono Quads., Monroe Co., Pa. ACD: May 1975.

A. A. DRAKE, JR., U.S. Geol. Survey. Allentown Quad. and Vicinity [eastern Pa.]. Project temporarily recessed.

J. B. EPSTEIN, U.S. Geol. Survey, W. D. SEVON, Pa. Geol. Survey, J. D. GLAESER, City Coll. of the City Univ. of N.Y., G. G. CONNALLY, SUNY at Buffalo, and A. G. EPSTEIN, U.S. Geol. Survey. Wind Gap Area, Pa. Mapping in Saylorsburg, Wind Gap, and Kunkletown Quads. ACD: 1976.

R. T. FAILL, Pa. Geol. Survey. Geology and Mineral Resources of the Montoursville South and Muncy Quads., Lycoming, Union, and Northumberland Cos. ACD: 1976.

R. T. FAILL and R. B. WELLS, Pa. Geol. Survey. Geology and Mineral Resources of Cogan Station and Salladasburg Quads., Lycoming Co., Pa. ACD: 1975.

R. T. FAILL and R. B. WELLS, Pa. Geol. Survey. Geology and Mineral Resources of Williamsport and Linden Quads., Lycoming Co., Pa. ACD: 1975.

A. D. GLOVER, Pa. Geol. Survey, and W. A. BRAGONIER, R & P Coal Co. Geology and Mineral Resources of the DuBois 15′ Quad., Jefferson and Clearfield Cos., Pa. ACD: May 1975.

A. D. GLOVER, J. H. WAY, JR., and R. T. FAILL, Pa. Geol. Survey. Geology and Mineral Resources of the Altoona 15′ Quad., Blair and Cambria Cos., Pa. ACD: 1976.

D. M. HOSKINS, Pa. Geol. Survey. Geology and Mineral Resources of the Millersburg Quad., Dauphin, Northumberland, and Snyder Cos., Pa. ACD: 1975.

J. D. INNERS and R. B. WELLS, Pa. Geol. Survey. Geology and Mineral Resources of the Bloomsburg-Berwick Area. ACD: 1980.

M. T. LUKERT and A. N. WARD, Edinboro and Slippery Rock State Colleges. Geology and Engineering Geology of Oil City Quad. ACD: 1976. Part of N.S.F. project on Environmental Geology applied to Rural-Urban needs.

S. I. ROOT, Pa. Geol. Survey. Geology and Mineral Resources of the Mechanicsburg and Carlisle 7½' Quads., Cumberland Co., Pa. ACD: 1976.

S. P. SCHWEINFURTH, U.S. Geol. Survey. Geology of the Claysville-Avella Area [Washington Co., Pa.]. In preparation: Geologic map of the Avella quad. and part of the Steubenville East quad.

W. D. SEVON, Pa. Geol. Survey. Surficial Geology of the Linden and and Williamsport Quad., Lycoming Co., Pa. ACD: 1975.

W. D. SEVON, Pa. Geol. Survey. Surficial Geology of the Salladasburg and Cogan Station Quads., Lycoming Co., Pa. ACD: 1975.

W. D. SEVON and T. M. BERG, Pa. Geol. Survey. Geology and Mineral Resources of the Skytop Quad., Monroe Co., Pa. ACD: 1975.

W. D. SEVON and T. M. BERG, Pa. Geol. Survey, and L. D. SCHULTZ, Gilbert Associates, Inc. Geology, Mineral Resources, and Environmental Characteristics of Pike Co., Pa. ACD: 1976.

R. B. WELLS, Pa. Geol. Survey. Geology and Mineral Resources of Montoursville North and Huntersville Quads., Lycoming Co., Pa. ACD: Dec. 1975.

G. H. WOOD, JR., U.S. Geol. Survey. Geology of the Southern and Eastern Middle Anthracite Fields, Pa. Project objectives are to map the complete geology of 25 quads. in the Southern and Eastern Middle Anthracite fields.

D. A. YOUNG, Univ. of N.C. at Wilmington. Geology of the Baltimore Gneiss near Philadelphia. ACD: 1978.

ECONOMIC GEOLOGY

P. C. BAZAKAS, The Pa. State Univ. at Ogontz. Lineament Analysis of Southeastern Pa. and N.J. in Relation to Location of Ore Deposits. An attempt is being made to relate lineaments on ERTS and Skylab imagery to ore deposits. ACD: June 1975.

M. J. BERGIN, U.S. Geol. Survey. Northern Anthracite Field. Work includes compilation of maps on anthracite-bearing rocks in the Kingston, Pittston, and Wilkes-Barre West quads. and field checking to complete compilation of the maps.

J. L. CRAFT, Pa. Geol. Survey. Sand and gravel resources of the upper Allegheny River, ACD: 1976.

J. M. DENNISON, Univ. of N.C. Occurrence of Oil and Gas in Appalachian Basin Related to Paleozoic Eustatic Sea-Level Changes. ACD: 1975.

J. M. DENNISON, Univ. of N.C. Nonmarine Stratigraphic Summary of Paleozoic Strata of Pa., N.Y., N.J., and Ohio and Emphasis on Factors Related to Uranium Potential. Compilation and evaluation being done on contract with ERDA. ACD: July 1975.

WALLACE deWITT, JR., L. D. HARRIS, R. L. MILLER, W. J. PERRY, JR. and L. G. WALLACE, U.S. Geol. Survey. Appalachian Basin Oil and Gas Potential. Purpose of the project is to make a regional synthesis of the basin, to study the occurrence of oil and gas in relation to stratigraphic units, their depositional and environmental history, and to the tectonic framework of the Appalachian basin. ACD: 1980.

W. E. EDMUNDS and M. A. SHOLES, Pa. Geol. Survey. Economic Geology of the Allegheny Group Coals, Brownsville-Connellsville 15' Quads., southwestern Pa. ACD: 1976.

W. E. EDMUNDS and M. A. SHOLES, Pa. Geol. Survey. Economic Geology of the Allegheny Group Coals, Freeport-Elders Ridge 15' Quads., western Pa.

R. B. FINKELMAN and HARRY KLEMIC, U.S. Geol. Survey. [No title given]. Identification of the primary uranium-bearing phase or phases in the uraniferous sandstone from Carbon Co., Pa. ACD: June 1975.

R. I. GRAUCH, U.S. Geol. Survey. Uranium Veins in the Eastern United States. Work plans are to compile maps showing nonsedimentary uranium occurrences in the eastern states. A detailed study of geologic mapping, a ground radiometric survey, and sampling of the known nonsedimentary uranium occurrence near Easton is planned.

J. C. GRIFFITHS, W. D. MENZIE, and M. LABOVITZ, The Pa. State Univ. Unit Regional Value of Natural Resources [U.S.A. in particular, S. Africa, Rhodesia]. Investigation aimed at evaluating unit regional value of earth's crust in terms of mineral resources (developed and potential). ACD: 1978.

ARTHUR JACOB, U.S. Geol. Survey. Basin Analysis of Uranium-Bearing Paleozoic Rocks in Eastern United States. Project includes field reconnaissance, detailed field and laboratory studies, literature review, and compilation of a map on uranium occurrences in the Appalachian basin.

W. S. LYTLE and LAJOS BALOGH, Pa. Geol. Survey. Oil and Gas Fields Map of Pa. The 1963 map (Pa. Geol. Survey Map 3) will be updated as of June 1975. ACD: 1975.

W. S. LYTLE, Pa. Geol. Survey, and petroleum engineers with oil companies in Pa. Updating of Mineral Resource Rept. 32, Crude Oil Reserves of Pa. ACD: 1975.

B. J. O'NEILL, JR., and Field Division, Pa. Geol. Survey. Investigations for High-Calcium Limestone for Use in Stack-Gas-Removal Systems. Objectives are threefold: (1) to sample and analyze limestone units where information is lacking, incomplete, or widely scattered; (2) to map any newly discovered high-calcium limestone unit that has a potential for commercial extraction; and (3) to synthesize the data into a publication which can be used as a guide to exploration targets. ACD: 1975.

B. J. O'NEILL, JR., Pa. Geol. Survey, and K. J. LILES, U.S.B.M. Properties and Uses of Pa. Shales and Clays—Greater Pittsburgh Region. A continuation of the series of programmed studies to evaluate the economic potential of shale-clay raw materials for ceramic and non-ceramic uses.

W. S. SILVERMAN, Univ. of Toledo. Determination of Mineralization Controls by Geochemical Analysis of Soils along Fracture Zones in the Northern Shenandoah Valley. A low-grade base metal geochemical soil anomaly has been found 20 mi. south of the Pa. State Line in W. Va. The sulfide mineralization found displays all the characteristics of the commercial "Appalachian Low Temperature Zinc Deposits." It is hoped that the data obtained can be applied up strike into Pa., finding economic targets. ACD: May 1975.

R. C. SMITH, II, Pa. Geol. Survey. Zinc-Lead Occurrences in Pa. Following location and description of sphalerite and/or galena occurrences, the samples collected are being prepared for analysis. Pure mineral separates will be analyzed for trace elements. These data are to be interpreted for economic byproduct, pathfinder, genetic, and environmental implications. ACD: 1976.

W. R. WAGNER and W. S. LYTLE, Pa. Geol. Survey. Revised Surface Structure Map of Greater Pittsburgh Area and Its Relation to Oil and Gas Fields. ACD: 1975.

ENGINEERING GEOLOGY

W. E. DAVIES, R. J. HACKMAN, VICTOR SEIDERS, and A. B. OLSON, U.S. Geol. Survey. Mined Land Reclamation—Safe Mine Waste Disposal [Appalachians]. The project involves preparation of a series of 1:250,000 scale maps indicating susceptibility to, and incidence of, slope failure. The maps will be based on photo-interpretation and field studies. ACD for Canton, Clarksburg, and Cumberland sheets is 1976–77. ACD for project is 1978.

A. J. DEPMAN, J. R. HARRIS, and R. G. LAZOR, U.S. Army Engineer Dist., Phila. Foundation Report Covering Geologic Structure—Blue Marsh Lake Project, Berks Co., Pa. Site geology and intimate geologic structures are defined as they affect the design and stability of a 100-ft.-high earth and rock fill dam. ACD: Mar. 1976.

N. K. FLINT, Univ. of Pgh., and W. R. ADAMS, JR., Allegheny Co. Planning Comm. Geologic Study of the Causes of Landsliding in Allegheny Co., Pa. ACD: 1976.

W. W. PARKER, S. R. MICHALSKI and J. P. NAIRN, GAI Consultants, Inc. Site Delineation of Coal Refuse Disposal Areas [central and northwestern Pa.]. The North-Central, Broad Top, Georges Creek, North Fringe and West Fringe of Main Bituminous Coal Fields are being investigated and mapped relative to the occurrence of coal waste disposal areas or related facilities that may pose a hazard or potential hazard to lives and/or property. ACD: May 1975.

F. E. SENFTLE, U.S. Geol. Survey. Uranium Disequilibrium Studies. Outcrop studies are underway at Penn Haven Junction to test a truck-mounted gamma-ray spectrometer for the distribution of uranium series isotopes.

C. E. TURNER, U.S. Geol. Survey. Basin Analysis as Related to Uranium Potential in Triassic Sedimentary Rocks, Eastern United States. Fieldwork is to begin in the Triassic Newark-Gettysburg basin of Pa. This includes examining, sampling, and describing known uranium occurrences and relating them to the sedimentary framework.

J. P. WILSHUSEN, Pa. Geol. Survey. Educational Series 9, Geologic Hazards in Pa. A descriptive report with some illustrations and maps to depict and locate areas of potential geologic hazards. ACD: July 1975.

ENVIRONMENTAL GEOLOGY

R. P. BRIGGS, U.S. Geol. Survey. Elements B and E through J of USGS-Appalachian Regional Commission Project: Water Resources Division, Topographic Division, and Geographic Applications Program Elements. Topographic, slope, and photo-image maps of the Monongahela River Basin; land-use change and slope maps of Allegheny Co.; and slope and land-use maps of Lycoming Co. are scheduled for completion by June 1975.

R. P. BRIGGS, U.S. Geol. Survey. Greater Pittsburgh Regional Studies. Distribute a wide variety of environmental interpretive and derivative maps, charts, and reports. Continue preparation of maps of Greater Pittsburgh region oil and gas fields, and mined-out areas, and Armstrong Co.'s overdip-slope map.

KENT BUSHNELL, Slippery Rock State Coll./U.S. Geol. Survey, and JOHN PEAK, Slippery Rock State Coll. Maps of the Pittsburgh and Upper Freeport Coal Beds, Outcrop, Overburden Mining Activity and Related Surface Subsidence, Allegheny, Washington and Westmoreland Cos., Pa. ACD: June 1975.

J. L. CRAFT, Pa. Geol. Survey. Environmental Geology related to Rural-Urban needs, Oil City Quadrangle. A N.S.F. funded project under RANN. To prepare basic geologic and interpretive maps and user-group manuals demonstrating use of geologic data in local land use decisions. ACD: 1976.

J. L. CRAFT, Pa. Geol. Survey. Overburden Thickness above the upper Freeport coal, Greater Pittsburgh Urban area. ACD: 1976.

J. R. EBY and R. R. PARIZEK, The Pa. State Univ. Geology and Ground Water Resources of the Potter Township Area, Centre Co., Pa. The project involves detailed geologic mapping and a study of the ground-water resources of Potter Township and vicinity, and will result in several maps useful to the planner. ACD: July 1975.

J. B. EPSTEIN, U.S. Geol. Survey. National Environmental Overview Program. This program is to summarize many of the characteristics and geographic distribution of earth materials and nature and extent of geologic processes in the U.S. Maps and reports will provide a geologic data base useful to the understanding of environmental problems on a national scale. Maps at a scale of 1:7,500,000 are to be published.

JACOB FREEDMAN and STEVEN SYLVESTER, Franklin and Marshall Coll. Analyses of Hair Samples for Excesses or Deficiencies of Trace Elements in Muscular Dystrophic Patients. Hair samples of healthy persons and muscular dystrophic patients analyzed so far indicate that there are differences in quantities and ratios of trace elements between the two experimental groups. ACD: Sept. 1975.

W. R. GOUGH, Moody & Assoc./The Pa. State Univ., and R. R. PARIZEK, The Pa. State Univ. The Geology and Water Resources of the Milesburg-Sayers Dam Area, Centre Co., Pa. ACD: Sept. 1975.

MOODY AND ASSOCIATES, INC. COWAMP-DER Comprehensive Water Quality Management Planning Study [34 counties in western, south-central and southeastern Pa.]. Basic inventories of existing published and unpublished data concerning geology, mineral resources, soils, ground-water availability and use, ground-water quality and land waste disposal sites have been completed during the initial year of the project for each study area. ACD: 1977.

G. H. MYER, Temple Univ. Heavy Metal Contamination of Tinicum Marsh, Phila., Pa. Diagenetic mineralogy and trace metal distribution in tidal marsh sediments over the last 50 years from approximately 20 cm cores.

J. M. WARD, B. C. ROTH, W. J. SCHETTIG, E. P. DUKE, P. A. BILZI, CHARLES WALTON, J. L. BUTLER, R. J. McELHINNY, Gwin, Dobson & Foreman, Inc. Toby Creek Mine Drainage Pollution Abatement Project SL-191 [Clarion Co.]. ACD: Dec. 1975.

J. M. WARD, B. C. ROTH, W. J. SCHETTIG, E. P. DUKE, P. A. BILZI, CHARLES WALTON, J. L. BUTLER, R. J. McELHINNY, Gwin, Dobson & Foreman, Inc. Deer Creek Mine Drainage Pollution Abatement Project SL-193 [Clarion Co.]. ACD: Dec. 1975.

GENERAL GEOLOGY

ALAN BILZI and E. J. CIOLKOSZ, The Pa. State Univ. The Genesis of Four Soils Developed in Recent Alluvium in Central Pa. Four soil profiles developed in recent alluvium were sampled for study. Radiocarbon dates will be studied and an attempt made to relate chronological age to pedological age. ACD: 1976.

E. J. CIOLKOSZ, R. P. MATELSKI, R. L. CUNNINGHAM, G. W. PETERSEN, and ROGER PENNOCK, JR., The Pa. State Univ. Classification and Genesis of Soils Developed in Floodplain and Terraces in the Jersey Shore and Muncy Areas of Pa. Eighteen soil profiles developed in terraces and floodplains at various elevations on the Susquehanna River were sampled for characterization analyses. Data will be evaluated in relation to the genesis and classification of these soils. ACD: 1975.

E. J. CIOLKOSZ, R. P. MATELSKI, R. L. CUNNINGHAM, G. W. PETERSEN and ROGER PENNOCK, JR., The Pa. State Univ. Characteristics and Genesis of Pa. Mine Soils. Twenty-two soil profiles developed in strip-mine material in western Pa. have been sampled for characterization analyses. In the summer of 1975 six additional profiles will be sampled in eastern Pa. These data will be interpreted in relation to soil genesis, soil classification, and possible land-use alternatives. ACD: 1976.

DONALD HOFF and EMILY GIFFIN, Pa. Historical and Museum Comm. Hall of Pa. Geology. Research to produce geological exhibits for the William Penn Mem. Museum, Harrisburg, Pa. ACD: Spring 1976.

S. KHOURY, J. WALLACH, J. TILLMAN, D. TRUESDELL, P. MULLER, B. ARCHER, J. FISCHER, T. GATES, Dames & Moore. Supplementary Geological Investigation [southern Lancaster Co.]. Stratigraphic, structural, and geophysical study as it pertains to nuclear power plant siting. Results of findings have led to changes in stratigraphic nomenclature and revision of structural and geophysical interpretations.

GEOCHEMISTRY

C. W. POTH, U.S. Geol. Survey. Ground-Water Quality in Pa. Between 4000 and 5000 U.S.G.S. analyses of water from about 2600 wells and springs have been computerized and will be used to give a statewide picture of ground-water quality. ACD: 1975.

A. W. ROSE, M. L. KEITH, N. H. SUHR, R. L. SCHMIERMUND, J. G. CROCK, The Pa. State Univ. Uranium Reconnaissance in Northeastern Pa. Using Geochemical Exploration. Techniques for reconnaissance detection of uranium deposits using stream sediments and waters are being tested at known occurrences. ACD: Sept. 1976.

H. A. TOURTELOT, U.S. Geol. Survey. Regional Geochemistry, Pittsburgh. This study of pollution in the Greater Pittsburgh region focuses on the naturally and technologically induced variations of chemical compositions of surficial materials and plants.

GEOMORPHOLOGY

W. B. WHITE, The Pa. State Univ. Caves of Pa. The object is to compile a complete catalog of the known caves of Pa. including description, map, and some geological interpretation. Data collection progresses on the caves of the Valley and Ridge. ACD: May 1975 (1st vol.)

W. B. WHITE and E. L. WHITE, The Pa. State Univ. Geomorphology of Appalachian Carbonate Terrains. This is a systematic investigation of the landforms and processes of all karst areas in the Appalachian Highlands from Pa. to Ala. We are devising quantitative measures of landforms, preparing detailed descriptions of selected areas or drainage basins, and attempting to relate structure, stratigraphy, and basin variables quantitatively to karst development. ACD: 1984.

GEOPHYSICS

JEFF DUNLEAVY and J. R. SUMNER, Lehigh Univ. Geophysical Investigation of the Triassic Basins. Gravity and magnetic data, combined with physical property measurements (density and magnetizations for the significant rock units), are being modelled to determine the structural framework, with special concentration over fans along northern margins of the basin. ACD: July 1975.

G. W. FISHER, Johns Hopkins Univ., M. W. HIGGINS and ISIDORE ZIETZ, U.S. Geol. Survey. Geologic Interpretation of Aeromagnetic Maps of Northeastern Appalachian Piedmont. We have been using aeromagnetic maps at a scale of 1:250,000 compiled by the U.S. Geol. Survey as a basis for regional, stratigraphic and structural interpretations of the Northeastern Piedmont. ACD: 1975.

ROBERT FLEMING and J. R. SUMNER, Lehigh Univ. Interpretation of Geophysical Anomalies over the Arcuate Appalachians. Gravity surveys over the southwestern end of the Scranton Gravity High resolve a separate high centered over New Bloomfield and connected to the main body of the gravity high by a saddle (9 mgal. relief between saddle and high). There is an associated magnetic anomaly. The preferred interpretation is a basalt sheet of Precambrian age. ACD: June 1975.

B. F. HOWELL, JR., The Pa. State Univ. Relative Seismic Hazard in the U.S. ACD: 1977.

J. C. HOWER, Ohio State Univ. Paleomagnetism of Ordovician Diabase of Lebanon Co. ACD: Fall, 1975.

P. M. LAVIN, F. J. SHAUB and DANIEL NEGRI, The Pa. State Univ. Gravity and Magnetic Studies in Pa. Current efforts are directed toward determining the structure of the Triassic Basin and the depth to basement in western Pa. ACD: 1977.

S. I. ROOT, Pa. Geol. Survey. Gravity Studies in the Gettysburg Basin of Pa. ACD: 1976.

S. I. ROOT, Pa. Geol. Survey. Magnetometer Study of the Triassic Dikes in Cumberland Co. ACD: 1976.

C. K. SCHORNBERGER, Millersville State Coll. Seismicity of Eastern Pa. A Sprengnether high-gain seismograph with a vertical short-period seismometer has been installed on the Millersville State Coll. campus. Operated in conjunction with similar instruments elsewhere in the state, this seismic system will detect and locate small earthquakes or explosions in eastern Pa. or adjacent regions.

K. W. VOLK, P. M. LAVIN, and A. W. ROSE, The Pa. State Univ. Paleomagnetism of Mesozoic Intrusives in Southeastern Pa. The paleomagnetism of diabase bodies is being used to determine the detailed late-stage tectonic history of the Triassic Basin in Pa. ACD: 1976.

ROB VAN der VOO and R. B. FRENCH, Univ. of Mich. Paleomagnetic Investigation of Paleozoic Rocks [Bedford-Lewistown, Pa.]. Samples from the Ordovocian Juniata Formation and the Silurian Clinton Formation are investigated paleomagnetically, in order to determine their directions of remanent magnetization. These directions and the corresponding paleomagnetic pole positions will be used for paleogeographic and plate tectonic analyses. ACD: 1976.

GLACIAL GEOLOGY

M. F. BUCEK, The Pa. State Univ. Pleistocene History of Williamsport and Muncy Area. ACD: 1975.

W. F. CHAPMAN, Slippery Rock State College. Glacial geology and economic resources of the Oil City Quadrangle. Part of N.S.F. project on Environmental Geology applied to Rural-Urban Areas. ACD: 1976.

D. R. COATES, SUNY at Binghamton. Quaternary Stratigraphy of N.Y. and Pa. This paper is largely a review of already published information but includes some new information and directions to be taken to solve some of the problems and correlations. ACD: June 1975.

R. G. CRAIG, The Pa. State Univ. Comparison of Patterns of ERTS-MSS and Glacial Drift [northwestern Pa.]. ACD: June 1975.

G. H. CROWL, Ohio Wesleyan Univ., W. D. SEVON and T. M. BERG, Pa. Geol. Survey, and G. G. CONNALLY, SUNY at Buffalo. The Late Wisconsinan Glacial Border in Eastern Pa. The Late Wisconsinan glacial border is now mapped from the Delaware River (Bangor quad.) to Rose Valley Lake north of Williamsport.

HYDROLOGY

E. S. BAIR and R. R. PARIZEK, The Pa. State Univ. Edgely Well Field Thermal Survey Study [Bristol, Bucks Co.]. The principal objective is to locate the zones of highest permeability in a discontinuous sand and gravel aquifer found beneath the floodplain of the Delaware River. ACD: Oct. 1975.

A. E. BECHER, U.S. Geol. Survey, and S. I. ROOT, Pa. Geol. Survey. Urban and Rural Ground-Water Hydrology in the Northern Part of the Cumberland Valley, Pa. ACD: 1976.

R. M. FOOSE, Amherst Coll. Ground Water Storage, Porosity, and Permeability in the Limestone Rocks of the Hershey Valley, Pa. Continuous hydrographs on six wells document the static water level in the limestones of the Valley.

D. J. GROWITZ, U.S. Geol. Survey. The Effect of Ground-Water Conditions on Local Flooding in the Kingston Area, Pa. ACD: Jan. 1975.

D. J. GROWITZ and R. R. BOLAM, U.S. Geol. Survey. Coal Mine Discharges in the Anthracite Fields of Pa. One main objective of the study is to gather hydrologic data for all significant sources of mine drainage during a high and low flow period. These data and other data will be used to evaluate mine drainage as a function of physiography, mining methods, time, and refuse disposal practices. In addition, the probable impact of future anthracite mining on the environment and methods of reducing any such impact will be examined. ACD: Aug. 1977.

J. H. GUSWA and R. R. PARIZEK, The Pa. State Univ. A Digital Model of the Aquifer System in the Coastal Plain Area of Southeastern Pa. The Coastal Plain area of southeastern Pa. was modeled as a multi-layered aquifer system. Simulation results support previous statements that large quantities of ground water are available to the area. ACD: Summer, 1975.

E. D. HESS, Pa. Geol. Survey. Pa. Water Well Inventory. Identification of lithologic units, positioning of wells by coordinates, and analysis of rock units as potential aquifers.

L. J. McGREEVY and R. A. SLOTO, U.S. Geol. Survey. Ground-Water Resources of Chester Co., Pa. ACD: July 1976.

E. T. SHUSTER, Pa. Geol. Survey. Hydrogeology of the DuBois Area, Jefferson and Clearfield Cos. ACD: 1976.

J. B. URBAN, U.S. Dept. of Agric., H. B. PIONKE, Research Leader, W. J. GBUREK, Research Hydraulic Engineer, A. S. ROGOWSKI, Soil Scientist, W. R. HEALD, Soil Scientist, and R. R. PARIZEK, The Pa. State Univ. Predicting Storm Runoff, Water Yield, and Water Movement in an Agricultural Watershed [North Atlantic Area]. Objective is to develop concepts and then to develop and test predictive models of water, sediment and chemical origin and transport on a watershed basis. The study areas consist of selected problem areas on land uses in the northeastern U.S. including a research watershed in central Pa.

R. K. WADDELL, JR. and R. R. PARIZEK, The Pa. State Univ. Acid and Iron Pollution Abatement. During the construction of I-80, placement of pyrite-containing fill material in a ground-water discharge area caused the production of acidic water analagous to acid mine drainage. This project includes measurement of pretreatment water chemistry, treatment by the spreading of flue dust and sawdust, seeding and mulching, and post-treatment monitoring of chemical charges. ACD: Summer 1976.

E. L. WHITE, The Pa. State Univ. Surface-Water Hydrology of Appalachian Carbonate Terrains, Centre, Mifflin, and Lehigh Cos. The object of this study is to find the relationships between surface flow in basins from 2 to 200 sq. mi. and the geologic and karst properties of each basin. ACD: June 1975.

E. L. WHITE and W. B. WHITE, The Pa. State Univ. Analysis of Limestone Spring Hydrographs [central Pa.]. Limestone springs draining open conduit aquifers are flashy; they respond rapidly to storm events. The characteristic response time (for discharge to fall to 1/e of its initial value) ranges from days to years and can be used to distinguish conduit, mixed, and fracture (diffuse) aquifers. ACD: Dec. 1975.

IGNEOUS AND METAMORPHIC PETROLOGY

A. A. DRAKE, JR., and R. I. TILLING, U.S. Geol. Survey. Petrochemistry of the Precambrian Rocks of the Reading Prong [eastern Pa., northern N.J., southern N.Y.]. Project temporarily recessed.

J. R. HUNTSMAN and W. A. CRAWFORD, Bryn Mawr Coll. Crystalline Rocks of the Wagontown 7½′ Quad. [Chester Co.]. Mapping has revealed at least two different groups of gneisses within this area—granulite gneisses associated with the anorthosite body, and banded gneisses in the southern half of the quad. ACD: 1975.

G. H. MYER and R. C. JOHNSON, Temple Univ. Metamorphic Petrology of Sillimanite Nodules, Wissahickon Schist, Phila., Pa.

MINERALOGY

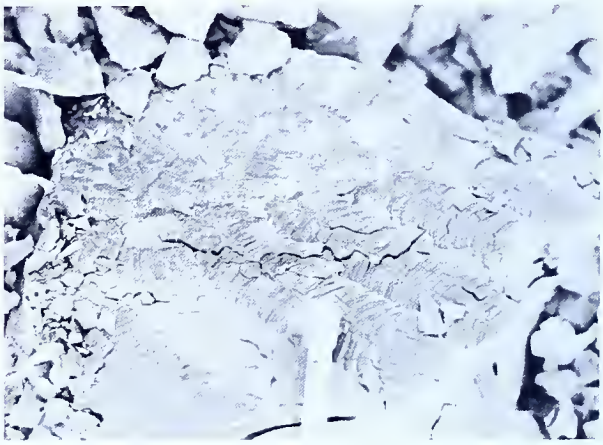
A. M. ALPER, R. W. WOLFE and S. T. BULJAN, GTE Sylvania. Phosphors, Tungsten Ores and Ceramics (Cordierite and Spodumene and Silicon Nitride).

J. H. BARNES, D. M. LAPHAM, Pa. Geol. Survey, and W. F. DOWNEY, JR., Juniata Coll. Mineralogy Associated with Burning Anthracite Deposits. A report on minerals forming from sublimation of gases produced by subsurface fires in anthracite mines and culm banks in Luzerne, Schuylkill, and northern Dauphin Cos. ACD: 1975.

R. B. FINKELMAN and M. E. MROSE, U.S. Geol. Survey. Description of the first natural occurrence of SeO_2. The new mineral was found on burning culm banks in the anthracite coal region. ACD: Aug. 1975.

A. R. GEYER, R. C. SMITH, II, and J. H. BARNES, Pa. Geol. Survey. Mineral Collecting in Pa. (4th ed.). This is a complete revision of the 1969 edition of Gen. Geology Rept. 33. ACD: Fall 1975.

PALEONTOLOGY



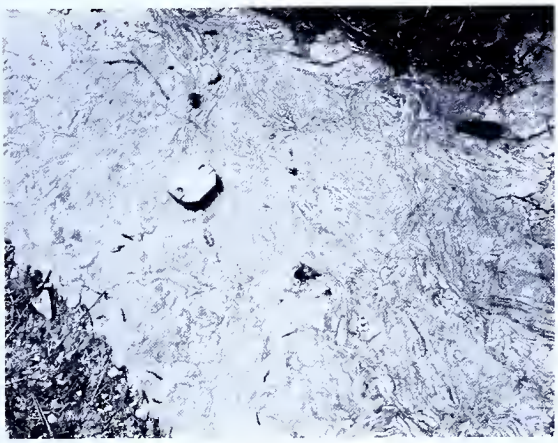
T. M. BERG, Pa. Geol. Survey, and R. E. THOMS, Portland State Univ. Burrow Structures of *Archanodon* (Devonian) Compared with *Margaritifera* (Holocene). Thoms plans aquarium studies on *Margaritifera,* while Berg continues the search for occurrences of *Archanodon* burrows which now includes localities in Pa., N.Y., and N.J.

BRUCE CORNET and ALFRED TRAVERSE, The Pa. State Univ. Palynology, Chronology, and Paleoecology of the Newark Group Basins in the Eastern U.S. At least 260 species of palynomorphs, including many new species, have so far been recovered from Newark Group Basins. The work includes investigation of several productive sections in the Gettysburg Basin of Pa. At least five types of microspore assemblages, each spanning a different time interval, have been recognized in these basins. ACD: 1976.

KEITH MADDEN, Stockton Coll., and H. G. RICHARDS, Acad. of Natural Sciences, Phila. Study of Pa. Plants from Vicinity of Saint Clair, Pa. Study of Pennsylvanian plants to be exhibited at Stockton Coll.

W. A. OLIVER, JR., U.S. Geol. Survey. Rugose Corals of the Keyser Limestone] Pa., Md., Va., W.Va.]. Systematics and biostratigraphy; field and laboratory work are in progress and comparisons with N.Y. sequence are being made. ACD: 1980.

B. R. WILSON and ALFRED TRAVERSE, The Pa. State Univ. Palynology of Some Carboniferous Rocks of the Allegheny Plateau, Western Pa. Allegheny Plateau rock units under palynostratigraphic investigation include those generally designated Pocono Formation and uppermost Catskill Formation. To date, the Pocono has been shown to be restricted to the Tournaisian Stage (Kinderhook—Osage), and to have a lower boundary which is transitional with the Devonian System.



SEDIMENTOLOGY

J. R. BEERBOWER, SUNY at Binghamton. Upper Devonian Terrestrial Habitats as Key to Tetrapod Evolution. Investigation of sedimentary and paleopedologic features of Catskill alluvial and deltaic deposits, particularly those with associated vertebrate and plant remains. Reconnaissance has revealed new fish localities and indicates they occur in overbank (levee and crevasse-splay) deposits. ACD: 1977 or 1978.

W. E. EDMUNDS, A. G. GLOVER, V. W. SKEMA, M. A. SHOLES, T. M. BERG, J. D. INNERS, Pa. Geol. Survey. TASIC. This project (Temporarily Available Stratigraphic Information Collection) is a continuing program involved with the recovery of stratigraphic data from active coal and clay strip mines and construction sites while exposures are available. The long-term project is designed to provide data for future mapping and regional mineral resource evaluation.

R. P. ENGELDER and J. C. GRIFFITHS, The Pa. State Univ. Petrology and Petrography of Chickies Quartzite [southeastern Pa.]. The Chickies quartzite possesses considerable variation in friability. Isolation of the factors which accompany this variation is the main objective of this study. However, preliminary investigation indicates that this rock unit is an arkose rather than a quartzite. ACD: 1976.

J. S. LYNN and W. D. MARTIN, Miami Univ. The Heavy Mineral Barite of the Dunkard Group (Upper Pennsylvanian) [southwest Pa., southeast Ohio, northern W. Va.]. This thesis study is to determine the origin of barite in the quartz sandstones of the Dunkard Group. ACD: Aug. 1975.

J. B. ROEN, U.S. Geol. Survey. Geology of the Sandstone above the Pittsburgh Coal Bed, Northern Appalachian Basin, Md., Ohio, Pa., and W. Va. A study of the stratigraphy, geometry, petrology and current structures of sandstone in the lower member of the Pittsburgh Fm.

R. G. WALKER, McMaster Univ., and J. C. HARMS, Marathon Oil Co. Sedimentology of Catskill Delta [south-central Pa.].

STRATIGRAPHY

PING-FAN CHEN, W. Va. Geol. Survey. Lower Paleozoic Stratigraphy, Tectonics, Paleogeography, and Oil Possibilities in Central Appalachians. A comprehensive study based on surface and subsurface information. ACD: 1975–76.

J. M. DENNISON, Univ. of N.C. Purcell Limestone and Its Equivalents in Appalachian Basin. Purcell limestone has been traced in outcrop south to near Roanoke, Va. and north in outcrop and subsurface to N.Y. where it passes into Cherry Valley limestone (Middle Devonian). Detailed sampling in progress aims to establish contemporaneity in addition to already established physical continuity. ACD: 1976.

R. T. FAILL, D. M. HOSKINS, and R. B. WELLS, Pa. Geol. Survey. Middle Devonian Stratigraphy in Central Pennsylvania: A Revision. Recognition of upward-coarsening cyclic sequences within the Middle Devonian Mahantango Fm. has produced a greater understanding of the sedimentology of this unit, and a consequent revision of stratigraphic nomenclature to reflect the lateral facies changes. ACD: 1975.

W. E. NUNAN, Univ. of N.C. Stratigraphy and Sedimentology—Loudoun and Weverton Formations [northern Va., Md., and southern Pa.]. ACD: Aug. 1975.

STRUCTURAL GEOLOGY

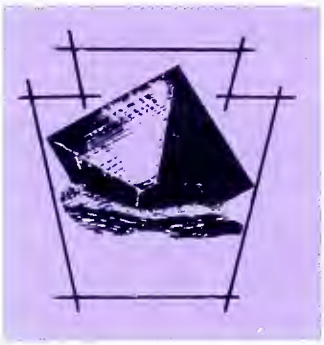
J. M. DENNISON, Univ. of N.C. Peridotites in Appalachian Basin Related to Keel-Line Fracture System. Work has just begun extending from Tenn. to N.Y. Fracture system could promote circulation of deep fluids. Has potential interest for geothermal power considerations. ACD: 1977.

R. T. FAILL, Pa. Geol. Survey. Fossil Deformation in the Valley and Ridge Province, Central Pa. Fossils throughout the province exhibit angular and shape distortions caused by a penetrative deformation. Crinoid columns have been collected and measured to evaluate this deformation. ACD: 1976.

PETER GEISER, Univ. of Conn. Dynamic and Kinematic Analysis of Pre-Folding Cleavage, Valley and Ridge Province. The foreland fold and thrust belt of central Pa. contains a pre-finite amplitude folding cleavage. The cleavage is a solution phenomena occurring in rocks ranging in age from Cambrian to Mississippian. It is presently hypothesized that the cleavage is associated with the emplacement of major thrust packages. ACD: 1978.

S. I. ROOT, Pa. Geol. Survey. Polyphase Deformation of the Martinsburg Formation, Harrisburg Area. ACD: 1976.

S. I. ROOT, Pa. Geol. Survey. Structural Geology of the Triassic Rocks in the Gettysburg Basin of Pa. ACD: 1976.



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Copies are available free of charge from Mr. William H. Bolles, Bureau of Curriculum Services, Department of Education, Harrisburg, Pennsylvania 17120.

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SURVEY ANNOUNCEMENTS

CORRECTION #1

Information Circular 76, "Potential High Calcium Limestones in the Mt. Joy area. . .", listed in Vol. 6/3 p. 9 as selling for $1.50 actually will cost $1.95 plus 6% sales tax for Pa. residents.

CORRECTION #2

The April 1975 issue of "Pennsylvania Geology," page 8, listed the wrong address from which to order two new U.S.G.S. maps. The correct address is Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St. Arlington, Va. 22202.

U.S.G.S. OPEN FILE ON URANIUM IN PENNSYLVANIA

The Pennsylvania Survey is pleased to announce an open file map by H. Klemic and M. Cooper of the U. S. Geological Survey on "Airborne radioactivity of parts of Carbon, Schuylkill, and Monroe counties, Pennsylvania." In addition to U.S.G.S. depositories, the Pennsylvania Survey has a hand-colored copy of Open File 75-91 for examination at its Executive House offices.

Despite a lack of correction of the radioactivity readings for elevation and detector lag, the map data appear useful for reconnaissance purposes. A brief examination of the data shows that the recorded radioactivity occurs over bedrock where there is little or no surficial cover; thick surficial cover of soil or glacial sediments may mask radioactive anomalies of the bedrock.

Although the known Mount Pisgah uranium occurrences did not show up very well on the U.S.G.S. radioactive maps, several other general areas of interest appear on the maps. However, they may represent many things other than mineable uranium orebodies.

STRATIGRAPHIC SECTIONS OF WESTERN MIDDLE ANTHRACITE FIELD ON OPEN FILE

The Pennsylvania Survey has received from Dr. Richard Bergenback, of the University of Tennessee at Chattanooga, a copy of a report on stratigraphy of Pennsylvania Period rocks in the Western Middle Anthracite Field. This report consists of a 7-page text and 4

plates containing described sections of the rocks in the lower part of the Pottsville and upper part of the Mauch Chunk Formations prepared while Dr. Bergenback was a member of the U.S.G.S. mapping team in the anthracite fields in 1950.

Microfilm copies are available free upon request to the Pennsylvania Geological Survey, P. O. Box 2357, Harrisburg, Pa. 17120, or the report may be inspected in the offices of the Survey, 914 Executive House, Second and Chestnut Streets.

LAND USE STUDY OF PENNSYLVANIA UNDER WAY

Detailed land use maps of the entire Commonwealth of Pennsylvania are being prepared by the U.S. Geological Survey under an agreement between the federal agency and the Pennsylvania Department of Environmental Resources. In announcing the signing of the project agreement, Environmental Resources Secretary Dr. Maurice Goddard noted that Pennsylvania will be one of the first states in the country to have complete land use map coverage under the sophisticated new system devised by the U.S. Geological Survey.

Utilizing the latest available photo imagery from high altitude reconnaissance planes and from satellites, the U.S. Geological Survey's electronic scanning equipment will delineate and map 36 separate land use categories. Land use can be detected and classified for areas as small as 10 acres. The final scale of the maps in preparation will be 1:250,000 or approximately one inch on the map equal to four miles on the ground.

One of the most important aspects of the U.S. Geological Survey mapping system is that the map data will be digitized so that it can be stored in a computer, reproduced, evaluated and analyzed in various ways, and readily updated as newer land use data becomes available in future years. Changes in land use will be identifiable, both as to type and quantity. With the land use data being digitized, it will be possible to feed into the system and print overlays of other mappable data, such as political and natural boundaries, and distribution of natural resources. Once completed, the land use maps and data bank will not only indicate present land uses, but will become a valuable aid for anyone involved in comprehensive land use planning.

The U. S. Geological Survey Land Use Data Analysis program (LUDA) was introduced and demonstrated last year at the annual meeting of the American Association of State Geologists. Impressed with the potential benefits that the U.S.G.S. system might provide for the Commonwealth, Pennsylvania State Geologist Arthur Socolow helped to establish liaison between the U.S.G.S. and DER's Bureau of Environmental Master Planning and the Bureau of Systems Analysis. The result is the DER-sponsored land use mapping herein described. The U. S. Geological Survey aims to complete the land use mapping project late in 1976.

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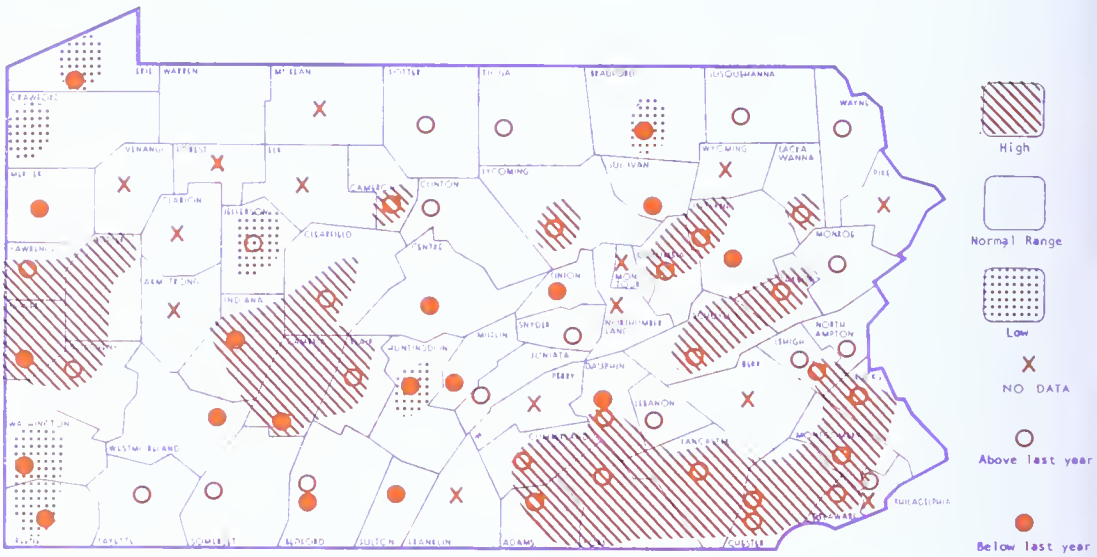

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PENNSYLVANIA GEOLOGY

THE PENNSYLVANIA GEOLOGICAL SURVEY
VOL. 6/5

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Cornwall Furnace and Museum along Route 322 at Cornwall, Pa. Open to the public and maintained by the Pennsylvania Historical and Museum Commission, this is the site of an iron mining and smelting operation dating back to pre-Revolutionary War years. Photo courtesy of Alan Geyer.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

OCTOBER 1975

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

LEARNING TO LIVE WITH NATURE'S VAGARIES

Now that there has been another Susquehanna River flood three years after the so-called "100-year" Agnes flood, the message is getting through that those statistical designations of 50, 100, and 200-year flooding do not prevent the possibility of repeated flooding every few years, or even oftener. And so it appears some sort of flood plain management bill may finally pass our state legislature. Such a bill could result in alleviating hardships of existing flood area installations and curtail potential new victims in flood-prone areas not yet developed.

But flooding is not the only natural hazard which Pennsylvanians have been facing in recent years. In southwestern Pennsylvania more and more cases are coming to light of home and business installations being damaged by landsliding. The topography (slope conditions) and physical nature of the rock formations of that area combine to result in large numbers of landslides. Recent mapping by federal, state, and university geologists indicates that there are thousands of recognizable landslides which have occurred in southwestern Pennsylvania, most before man even inhabited the area.

In south-central Pennsylvania we are hearing of more and more cases of damage resulting from new sinkhole collapses where development has taken place on top of limestone formations.

The increased incidence of landslide and sinkhole damage is largely the result of increased land development. Thus, in southwestern Pennsylvania previously untouched slope areas are now being disturbed by home, highway, or business construction—and landslides result. In south-central Pennsylvania some of our prime farmland, underlain by limestone which yields the good soil, is being overrun by housing developments; concentrated housing expedites sinkhole collapses; buildings suffer more from sinkholes than does tilled farmland.

As with flood-prone areas, we owe it to our fellow citizens to delineate the problem areas, and by education or some sort of local action, to control construction on areas prone to landslides or sinkholes. If it is possible to forestall new damage and hardships by landslides or sinkhole collapse, we would be doing a service not only to the potential victims, but also to all Pennsylvania residents. Each of us is affected in one way or another when some of our fellow citizens are hit by one of nature's disasters.

Arthur A. Socolow

The State Line District's Many Rock Types

by D. M. Lapham*

The Commonwealth of Pennsylvania can be divided into different geological areas, each with its own characteristic group of rocks (Fig. 1). Where among all our geologic diversity can the greatest number of different rock types be found? The Plateau with its dominant shale, siltstone and coal and the Triassic basin with its red shale, siltstone, conglomerate and diabase are perhaps the most uniform. The Great Valley and the Valley and Ridge, which lie between the Plateau and the Triassic rocks, exhibit a similar range of rocks. The old Piedmont in the southeast part of Pennsylvania contains many more rock types than any of these areas, perhaps even more than the Reading Prong, a narrow belt of Precambrian and Cambrian rocks that outcrop eastward from Reading.

One very complex area in the Piedmont lies just west of Philadelphia. Here, there are Precambrian-age mafic and granitic gneisses folded with Wissahickon Schist along with some Cockeysville Marble, amphibolite, and serpentinite. A few pegmatites and diabase dikes intrude the schists and gneisses and not far away is the eastern termination of the Peach Bottom Slate. Another area that includes a wide

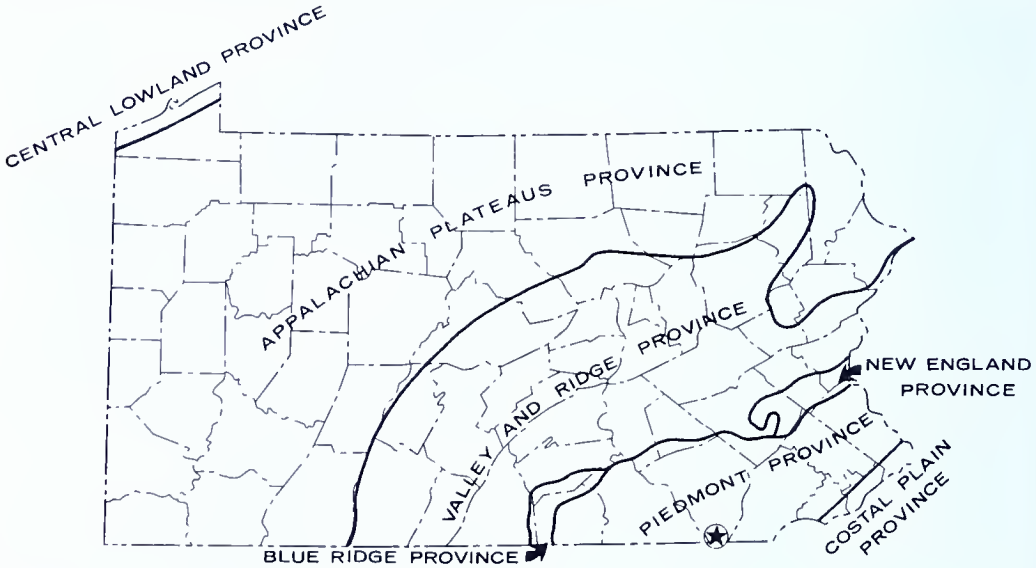

Fig. 1. Province map of Pennsylvania illustrating area of Lancaster County that is illustrated by more detailed map of Figure 2.

* This was the last article written by Dr. Lapham prior to his death in December, 1974.

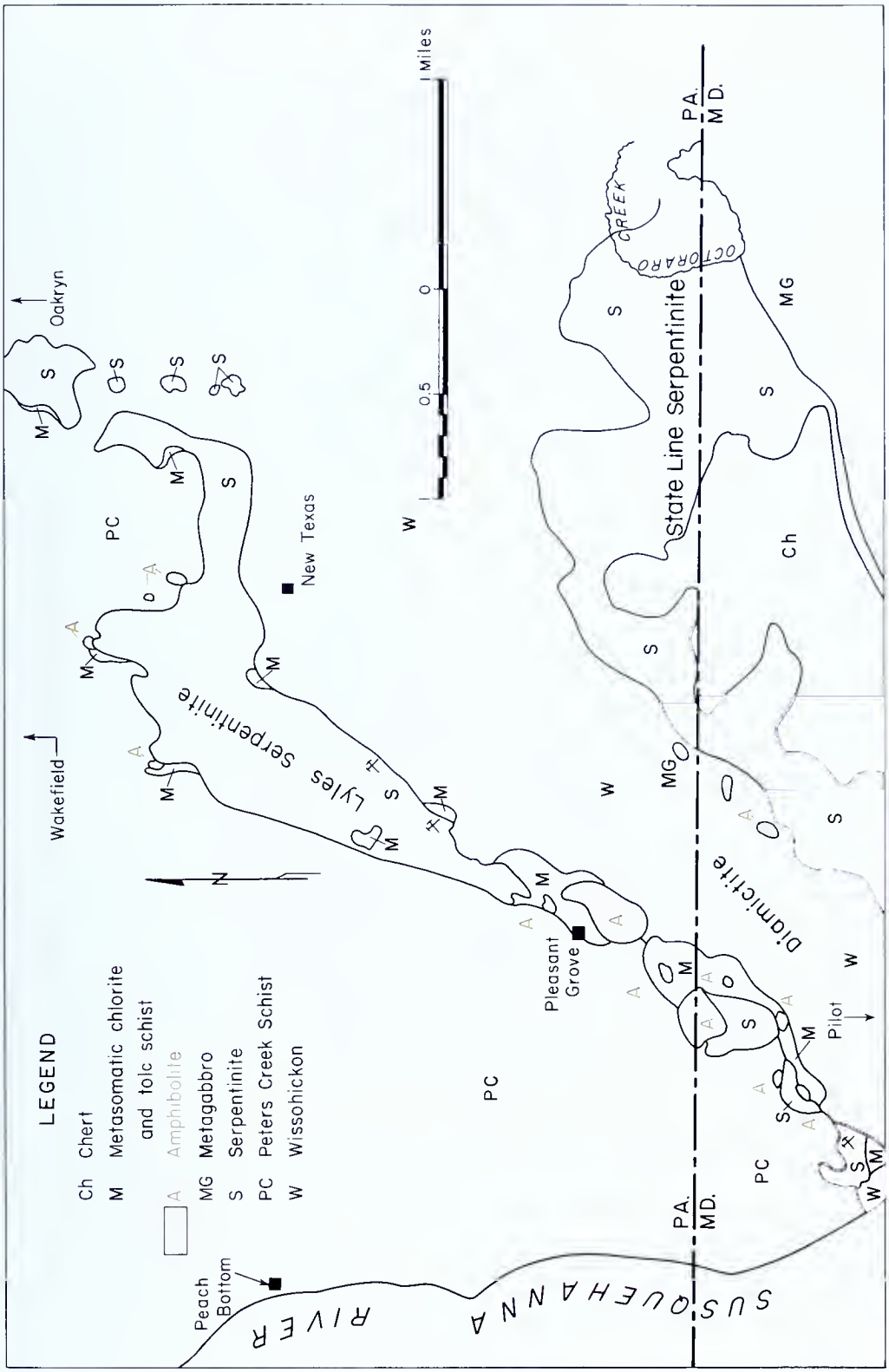

Fig. 2. Generalized lithologic map of southwestern Lancaster County illustrating major rock types of the area.

range of rock types is near Honeybrook. Here there are granitic to mafic schists, gneisses, and amphibolites of several varieties along wtih igneous pegmatites, anorthosite (plagioclase-rich rock), and diabase dikes. Serpentinites, quartzites, and limestones are nearby. However, mapping and petrography by D. M. Lapham of the Survey Staff has revealed another area that may have an even greater number of rock types in just a very few square miles, perhaps more than anywhere else in the state: the so-called State Line District of southern Lancaster County (Fig. 2). Among the igneous, meta-igneous, and metasedimentary rock groups so common throughout the Piedmont, more than 35 different rock types have been recognized from the Susquehanna River east to Octoraro Creek and from Wakefield south to the Maryland Line!

An almost endless subdivision of the rocks can be made for this area, although some of the finer points of distinction become rather arbitrary because of numerous gradations from one rock type (or facies) into another. Beyond the three major groups noted above, there are six large sub-groups: 1) metamorphosed sedimentary rocks, 2) metamorphosed volcanic rocks, 3) ultramafic igneous rocks, 4) mafic rocks both metamorphosed and some essentially unaltered, 5) granitic rocks, both of metamorphic and igneous origin, and 6) a large variety of highly altered (metasomatic) types generally along the margins of the igneous plutons. Almost all of the original rocks have been metamorphosed several times during the Paleozoic era and some have been further altered by heat and chemical reaction where they are in contact with surrounding rocks of different composition. The result has been an almost bewildering complexity, one made more difficult to decipher by a lack of good outcrops and a commonly dense vegetation in the area. In fact, much of the area is referred to as "the Barrens" because of its inhospitable nature:a thin, high-magnesium and low-potassium soil overgrown with cedars, scrub pine, and brambles.

Within the six sub-groups of rock types, there are approximately 23 different major rock types, excluding hybrids that resulted from an intermixing of two or more rock types. Among the metamorphosed sedimentary rocks, sequences of lithologies referred to as the Wissahickon and Peters Creek formations, are many quartz-mica schists. Some are fine-grained (to phyllitic) and some are coarse-grained; some are rich in biotite or chlorite; others contain some feldspar. Garnet and limonite pseudomorphs are sporadically abundant. All are well-foliated with good cleavage. Beds of these units are separated by metamorphosed sub-graywackes (quartz-rich with feldspar, mica, some

Fig. 3. Rolled quartzite, south of Pleasant Grove, Lancaster County.

chlorite, and rarely carbonate) and some quartzites (Fig. 3). These quartz-rich lithologies commonly exhibit graded bedding that indicates both overturned and right-side-up beds. Other units present include a quartz breccia, a quartz-pebble conglomerate, marble, slate (the Peach Bottom Slate just north of Wakefield), and a meta-sediment called a diamictite that contains metamorphosed fragments of other sedimentary rocks. This latter unit is the southern-most of the metasediments in Lancaster County and, where present, lies along the north edge of the State Line serpentinite near the Maryland border.

Volcanic rocks of extrusive origin can be difficult to recognize after the several stages of metamorphism such as occurred here in the Piedmont. For example, a pyroclastic tuff can resemble other schistose metasediments; in addition, volcanic rocks of basic composition such as basalts may become altered to amphibolites that closely resemble amphibolites of metasedimentary origin. Relicts of an original pillow lava have not been recognized here, although they do occur further south in the Maryland Piedmont. To date, the thin greenstones within the Wissahickon and Peters Creek formations probably are the most likely candidates for an originally volcanic rock, although all primary textures such as vesicular or flow structures are now missing. These thin greenstone interbeds (Fig. 4) essentially are composed of epidote, chlorite, and quartz. Another possibly volcanic rock is amphibolite. However, mapping has shown that these bodies are lenticular, not sheet-shaped as are most extrusive flows, and hence they probably are altered intrusive igneous plutons.

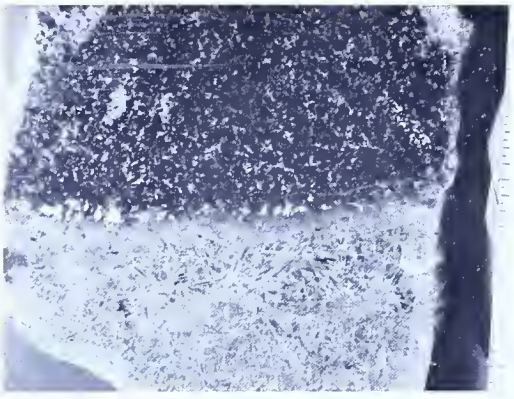

Fig. 4. Apatite at contact of hornblendite (black) and epidotite (gray), south of Pleasant Grove, Lancaster County.

Fig. 5. Chrysotile veinlets in serpentinite, northwest of Line Pit, at north contact of State Line Serpentinite, Lancaster County.

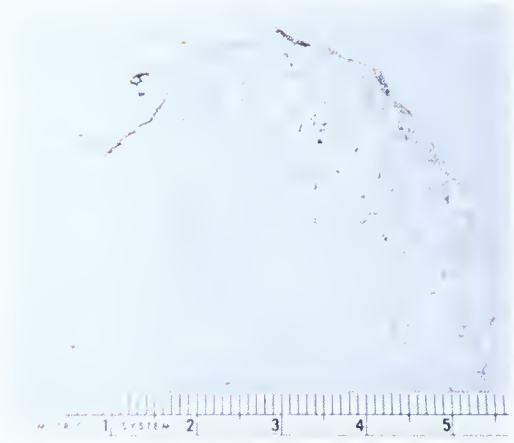

Fig. 6. Metamorphosed granitic breccia, north of New Texas, Lancaster County.

The ultramafic igneous rocks are varieties of serpentinite such as serpentinized dunite (Fig. 5) and harzburgite or, less commonly, altered pyroxenite (wherlite). All of these ultramafites occur in a band along the Pennsylvania-Maryland state line, on the south edge of the metasediments. Within this ultramafite band, the serpentinites form the north margin (along with chromite pods and bands) and the

pyroxenites lie to the south of them. Still farther south, rarely extending from Maryland into Pennsylvania, are the metamorphosed mafic rocks: gabbro, norite, and amphibolite (a gabbro altered to amphibole minerals; Fig. 4). Amphibolites (primarily hornblende or actinolite-rich rocks with epidote) also occur farther north at the contacts of serpentinite with country rock, particularly just south of Pleasant Grove, Lancaster County. Some amphibolites are rich in apatite. Igneous Triassic diabase dikes only a few tens of feet thick cut all these units and are the youngest (about 195 million years old) igneous rocks in the area. Finally, as a result of more recent alteration, all the serpentinites above an elevation of about 400 feet have been weathered to a red chert, principally by the loss of magnesium from serpentinite.

Rocks of granitic composition are not widespread but do occur here. Igneous pegmatites, commonly with black tourmaline (schorl), transect both the country rock and the serpentinite. Most pegmatites are simple quartz-plagioclase (albite-oligoclase)—muscovite pegmatites, some with chlorite or ilmenite present. Other granitic-appearing rocks probably are metamorphic in origin. These latter types occur in chloritic schists near Pleasant Grove and north of New Texas (Fig. 6), principally between the two belts of serpentinite (the northern Lyles serpentinite and the southern State Line serpentinite).

Finally, there are the metasomatic rocks along the margins of igneous bodies. All of them are gradational, indicative of an origin by chemical reaction between the igneous and metasedimentary rocks, but most tend to exhibit one dominant mineral. Thus, the most abundant are chlorite schist ("blackwall"), talc schist (steatite), tremolite schist and graphite schist. The tremolite schist always contains some talc and is most prevalent between Pilot, Maryland and Pleasant Grove, Pennsylvania. Some chlorite is unusually interesting because of concentrations of radioactive zircon, rutile, or magnetite. Graphite schist is rare and has only been identified from a serpentinite contact south of Oakryn, Pennsylvania and near the Peach Bottom Slate contact with the Peters Creek Formation.

Anyone interested in building up a collection of different, even strange, rock types should visit this area. Each rock that is broken open with a hammer will yield its own story and most samples will be as different from each other as these rocks are from the more common limestones, dolomites, shales, and sandstones that comprise so much of Pennsylvania's geological terrain. Furthermore, a geological look at this area affords a rare opportunity: few areas in the world are as complexly interesting as this, and it's right in our own backyard.

Invertebrate Fossils in the Upper Mahantango Formation, Suedberg, Schuylkill County, Pennsylvania

by
Jon D. Inners and
Eugene D. Hess

As part of an effort to assemble a Paleontologic Reference Collection which might prove useful to geologists working on projects within the state, the Pennsylvania Geological Survey is presently cataloging numerous new fossil collecting localities. One of the most accessible and interesting of these new sites is a borrow pit within the bounds of proposed Swatara Gap State Park, on the south side of Township Road 365, 0.75 miles southwest of Suedberg, Schuylkill Co. (Fig. 1). (Lat. 40°31'18"N, Long. 76°28'45"W, southwest portion of Pine Grove 7½' Quad.). Ample parking space is available on the floor of the pit.

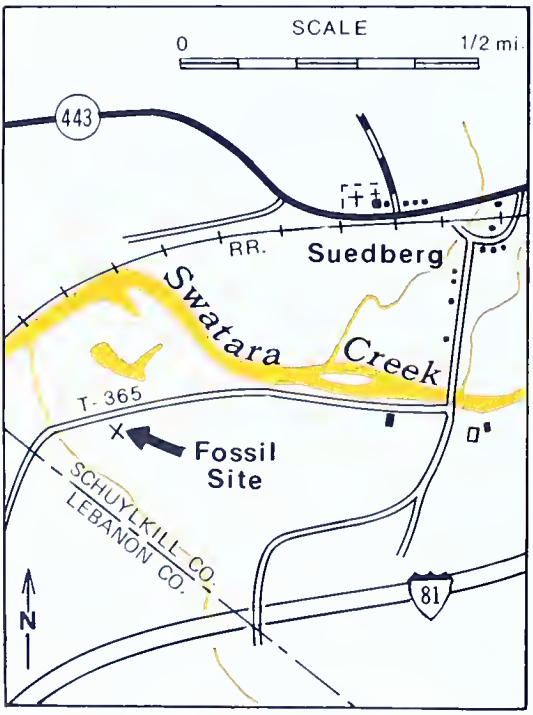

Fig. 1. Location of fossil collecting site.

The beds exposed in the borrow pit are intensely jointed, olive gray, fossiliferous, silty claystones and clayey siltstones of the upper Mahantango Formation (Middle Devonian) (Wood and Kehn, 1968). Fossils are most abundant in several deeply weathered, coquinite bands 2 to 3 inches thick that crop out at the western end of the pit. The attitude of these fossiliferous layers shows that bedding strikes north 65° east and dips 80° to the northwest. Spheroidal structures that are prominently developed on the steeply dipping bedding surfaces are weathering phenomena caused by exfoliation along closely spaced joint, fracture, and bedding planes. (See Sevon, 1974, p. 137).

Fossils in the weathered coquinites consist predominantly of internal and external molds of brachiopods and bryozoans. Pelecypods preserved as delicate white casts can be found in silty clay shales on the east side of the borrow pit (at a somewhat lower stratigraphic horizon than the coquinites). Material in these casts has been identified by X-ray diffraction as a mixture of very fine grained quartz and muscovite (John H. Barnes, Jr., personal communication). Species which have been identified include the following (a = abundant; c = common; unc = uncommon; r = rare):

Bryozoans
- *Fenestella* cf. *F. emaciata* Hall (a)

Brachiopods
- *Tropidoleptus carinatus* (Conrad) (unc)
- *Leptaena "rhomboidalis"* (Wilckens) (c)
- *Douvillina (Douvillina) inaequistriata* (Conrad) (unc)
- *Retichonetes vicinus* (Castelnau) (unc)
- *Spinatrypa spinosa* (Hall) (a)
- *Tylothyris pauliformis* (J. S. Williams) (a)

Pelecypods
- *Nucula* sp (c)
- *Paleoneilo* sp. (unc)
- *Modiomorpha concentrica* (Conrad) (unc)
- *Cypricardinia indenta* (Conrad) (r)

Crinoids
- Unidentified columnals (a)

Ostracodes
- *Hibbardia lacrimosa* (Swartz and Oriel) (r)
- Unidentified valves (c)

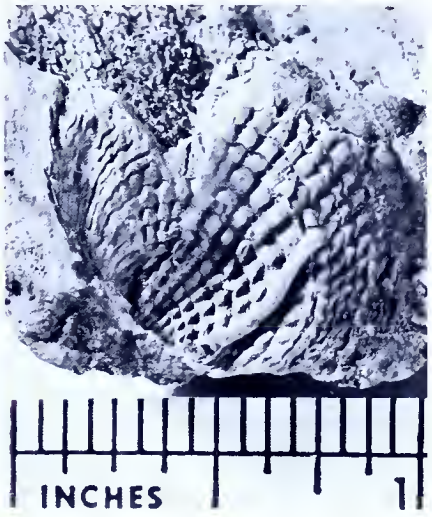

Figure 2. Worm (?) boring preserved as cast in external mold of pedicle valve of *Spinatrypa spinosa*. Note colony of *Fenestella* cf. *F. emaciata* (external mold of obverse side) in upper left. (Photo by L. Chubb.)

This fauna is typical of the *Sulcoretepora* cf. *S. inciscurata* Assemblage Zone of Ellison (1965), the uppermost biostratigraphic unit in the Mahantango Formation of central Pennsylvania. The occurrence of *Spinatrypa spinosa* and *Tylothyris pauliformis* (a small spiriferid) is also suggestive of the Tully Fossil Zone of Sevon (1974) in the Lehigh River Valley. (See Heckel, 1969, p. 10.)

The fossiliferous claystones and siltstones of the upper Mahantango Formation were deposited in a sublittoral marine environment. Recurrent communities of filter-feeding invertebrates, particularly bryozoans, brachiopods and crinoids, proliferated on the sea floor in areas of gentle wave or current agitation. The death of these organisms and the post-mortem concentration of their hard parts resulted in the formation of thin, lenticular shell beds (the coquinites at Suedberg). Demise of some individuals of *Spinatrypa spinosa* may have been hastened by the occurrence of parasitic worms (?) within their shell substance (Fig. 2).

Alan R. Geyer, Evan T. Shuster, and John H. Barnes, Jr., generously provided the writers with information concerning this site.

References cited are available upon request.

Oil Well Drilling in 1974

The petroleum industry drilled 16 new-field wildcat wells in Pennsylvania during 1974, of which 14 were dry holes, according to the Associated Petroleum Industries of Pennsylvania. The two successful drillings were both producers of oil but not gas.

Frank J. Bowden, Jr., APIP executive director, said the final 1974 drilling figures recently published by the American Petroleum Institute show a 10 percent increase in drilling activity in Pennsylvania during 1974, with a total of 1,208 wells drilled as compared to the 1973 total of 1,099.

Nationally there was a 19 percent increase, with the total number of wells completed during the year reaching 31,698, compared to 26,592 in 1973. Of the total, 5,652 were new-field wildcats—wells drilled in areas or formations never before productive—and of those, 4,847, or nearly 86 percent, proved to be dry holes.

current status of bureau's water well inventory

Evan T. Shuster

With two exceptions, computerized water well data now exists at the Pennsylvania Geological Survey for all counties of Pennsylvania. The exceptions are Philadelphia County for which no wells have been reported and Crawford County which is to be done by the U.S.G.S. The computerized data comes as a packet of four separate printouts. The first printout, called "Report Type A" shows the township, well number, owner, well location by latitude and longitude and the well use. The second printout is called "Report Type B" and lists the total depth of the well, casing length, screening, drilling method, water level, yield and drawdown. "Report Type C" identifies the topographic setting, the major and minor aquifers, depth to bedrock, type of bedrock and type of surficial material. The fourth set of printouts is "Report Type P" which adds the depths and yields of the water-bearing zones. The township and well number are used as the cross reference between the printouts. The following table lists, for each county, the number of wells currently in the computer system, the total number of printout pages (includes all four report types), and the approximate number of unprocessed well completion cards. The latter are the raw data as supplied by the well driller.

The water well data which is in the computer, as well as the unprocessed well cards, are on open file at the Survey's Harrisburg office, Room 901 Executive House, 2nd and Chestnut Streets. The printouts are also available to the public on request. If ten or fewer sheets are desired, there is no charge. Because of the cost factor, it may be beneficial for those requesting the data to be specific about the township as well as the type of data needed, i.e. Report Types A, B, C or P. All wells are grouped by township with the township arranged alphabetically. Photocopies of the unprocessed well completion cards may also be requested at the same charge per sheet as the printouts. Three well completion cards will copy onto one legal-size sheet. All requests for well data should be sent to Mr. Eugene Hess, Environmental Geology Division, Bureau of Topographic and Geologic Survey, Room 901 Executive House, Harrisburg, Pennsylvania 17101.

Our current activities in the water well inventory program are directed at updating some of the older county printouts, reducing the backlog of unprocessed well completion cards, and correcting, where

TABLE 1. WATER WELL INVENTORY SYSTEM

	County	No. of Printout Sheets	No. of Wells in Computer System	No. of Unprocessed Wells		County	No. of Printout Sheets	No. of Wells in Computer System	No. of Unprocessed Wells
1	Adams	18	202	190	35	Lackawanna	16	116	450
2	Allegheny	32	204	50	36	Lancaster	160	1145	2700
3	Armstrong	32	204	550	37	Lawrence	12	65	375
4	Beaver	40	281	100	38	Lebanon	104	731	600
5	Bedford	184	1333	900	39	Lehigh	152	1084	600
6	Berks	68	469	1350	40	Luzerne	44	300	615
7	Blair	52	355	1200	41	Lycoming	64	442	510
8	Bradford	44	319	1275	42	McKean	16	89	345
9	Bucks	244	1762	2000	43	Mercer	24	170	75
10	Butler	64	439	1000	44	Mifflin	68	466	160
11	Cambria	68	474	1200	45	Monroe	276	1989	2000
12	Cameron	12	77	25	46	Montgomery	92	647	900
13	Carbon	32	205	800	47	Montour	20	128	210
14	Centre	24	171	375	48	Northampton	76	540	460
15	Chester	192	1375	1425	49	Northumberland	52	357	190
16	Clarion	12	69	275	50	Perry	16	104	400
17	Clearfield	12	59	130	51	Philadelphia	N/W	N/W	N/W
18	Clinton	20	124	400	52	Pike	28	188	360
19	Columbia	28	201	25	53	Potter	40	275	375
20	Crawford	N/A	N/A	2925	54	Schuylkill	60	448	580
21	Cumberland	64	449	1100	55	Snyder	16	92	525
22	Dauphin	40	273	1275	56	Somerset	241	166	580
23	Delaware	12	77	100	57	Sullivan	32	217	75
24	Elk	8	41	100	58	Susquehanna	12	71	360
25	Erie	40	274	1075	59	Tioga	20	140	300
26	Fayette	8	36	180	60	Union	68	475	300
27	Forest	12	80	375	61	Venango	48	323	500
28	Franklin	92	646	225	62	Warren	12	66	150
29	Fulton	8	33	30	63	Washington	52	355	900
30	Greene	8	55	100	64	Wayne	40	285	390
31	Huntingdon	12	62	285	65	Westmoreland	36	237	975
32	Indiana	44	300	750	66	Wyoming	4	21	225
33	Jefferson	40	272	190	67	York	104	746	750
34	Juniata	12	73	180		TOTAL	3,376	23,482	39,595

possible, the original computerized data. We are now trying to get the well drillers to submit more accurate and detailed well location descriptions so that overall use and confidence in the program is increased. Also available with the computer printouts is a recently revised guide which describes and translates the different entries on the printout. This guide is supplied free of charge.

Data from our water well inventory are increasingly popular. Planners, engineers, geologists, well drillers and developers are making more and more use of the data. The water well information can be used to define some engineering characteristics of different rock units such as depth to competent bedrock water levels, and rock type or lithology. Hydrologic parameters, of course, are either listed on the printout or can be easily derived. Among these are well yields, specific capacities, depth to water-bearing zones, static water levels, expected well depths in an area or rock unit, etc. Although the well location and the rock unit are given, the computerized data are not directly adaptable to detailed geologic mapping; however, the actual well completion cards with the complete driller's log are of considerable help to geologic mappers.

Honors to Professor Edgar T. Wherry

Professor Edgar T. Wherry has been elected to the Honorary Life Presidency of the Mineralogical Society of America. We extend our congratulations to Professor Wherry for this well deserved recognition. Professor Wherry is an outstanding scientist who has made many distinguished contributions to geology and botany. His bibliographic citations number in the hundreds. Pennsylvania can truly be proud of this distinguished scientist. We congratulate him and wish him well.

Volunteer Work on Fossil Collections

Mr. Thomas Seaker, a second-year student from Bishop McDevitt High School in Harrisburg, has kindly volunteered his time and talent for one and one-half months during this summer, working on the Survey's fossil collections. He has carefully completed unwrapping, repairing, and relabeling specimens that were damaged during the 1972 flood. Our fossil collections are now completely stored in metal cabinets, but much organizational work and cataloguing still needs to be done. Mr. Seaker has also prepared a large supply of specimens for trading and free distribution to the public. The Survey is indebted to Tom for his conscientious volunteer work. We wish him the best of luck in his scientific endeavors.

SURVEY ANNOUNCEMENTS

COAL DATA PUBLISHED

Having sampled and recorded the geology at several hundred coal localities of western Pennsylvania, the Pennsylvania Geological Survey has reported its data and findings in Mineral Resources Report M 69, *Analyses and Measured Sections of Pennsylvania Bituminous Coal.*

This publication is part of a continuing investigation of coal resources in the bituminous coal region of Pennsylvania by the Pennsylvania Geological Survey. A similar report, Mineral Resource Report 66, containing data collected in prior years, was published earlier.

These reports are of benefit to all concerned with coal development and land-use planning of coal-bearing areas. The data on coal, particularly thickness, chemical analysis, and coking and fusibility characteristics, should be helpful for preliminary evaluation of the potential use of specific coal seams and for planning the development of the seams. The lithologic, paleontologic, mineralogic, and structural information will be useful to geologists for stratigraphic correlation and for sedimentary, structural, and other studies. The report also contains information relevant to environmental and engineering studies, dealing with such problems as pollution control, engineering construction, efficient mining technology, and urban or rural planning.

Bulletin M 69 is available for $4.00 (plus sales tax) from the Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.

STATE MAP AGAIN AVAILABLE

We are pleased to announce that the large Geologic Map of Pennsylvania is again available at the State Book Store. Due to a surge in demand, the supply of the map was exhausted for several months. We have reprinted and restocked this basic map. This is Map #1, 1960 edition, scale 1:250,000 (1 inch = 4 miles) and sells for $3.75 plus tax from Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.

A REPORT ON SUBSURFACE WATER IN LACKAWANNA COUNTY

A detailed inventory and evaluation of the subsurface water resources of Lackawanna County is presented in the Pennsylvania Geological Survey's new publication, Water Resources Report W 41, *Ground Water Resources of Lackawanna County*.

The development of water resources to meet increasing demands requires knowledge of the availability, distribution, quality, and use of water. Such information is essential to the orderly and economical planning, construction, and operation of facilities that will provide water to satisfy increasing needs. This study was made to provide such information on the available ground water in the county. The report also describes the distribution and movement of water in the underground mines and also the effect mine-water discharge has upon the Lackawanna River.

Many water-related problems exist in the county that inhibit, and in some places prevent, ground-water development. The four major problems of low-yielding wells, inadequate supplies for public water companies, poor-quality water, and pollution are discussed in detail. These results should be of assistance to planners, construction people, industry, and homeowners, all of whom at various times deal with or are affected by the occurrence and quality of the subsurface water in the area. This investigation is part of a continuing study of ground-water resources of Pennsylvania by the U. S. Geological Survey in cooperation with the Pennsylvania Geological Survey.

Water Resources Report W 41 is available for $11.65 (plus sales tax) from the Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.

SPELEOLOGICAL RELEASE

The first volume of a new series on caves throughout the Commonwealth has recently been published by the Pennsylvania Geological Survey. *Caves of Southeastern Pennsylvania,* compiled by J. R. Reich, Jr., lists over 90 caves in Adams, Bucks, Chester, Delaware, Lancaster, Montgomery, Philadelphia, and York Counties. The report lists the cave locations and summarizes some of the history, geology and characteristics of the individual caves, including plan and cross-sectional map views of most caves described. With the aid of this guide the reader will recognize the delicate and fragile beauty that this under-

ground world holds in store. General Geology Report 65, with 120 pages of text, 47 figures, and 17 plates, sells for $5.30, plus 6% tax, and is available at the Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pennsylvania 17125.

ERIE COUNTY YIELDS ANCIENT ROCKS

Applied and academic geologists will benefit from the Pennsylvania Geologic Survey's new Information Circular 79, *Interpretation of Isotopic Dates from a Precambrian Core in Erie County*.

A well drilled near Lake Erie in Pennsylvania penetrated Precambrian rocks at a depth of 5952 feet and provided an excellent opportunity to describe in detail these rock types that up to now have been inaccessible. Included in the new report are petrographic descriptions, radiometric age dates and a description of the complex events which, at least locally, have affected the rocks.

The oldest rock found in the core is a gneiss at least 1100 million years old and perhaps older; it is believed to have been an ancient lava flow. The youngest recorded alteration occurred about 550 million years ago and is believed to have been a chemical leaching.

The results of this study are significant: Precambrian rocks now definitely have been identified from beneath the plateau of northwestern Pennsylvania; their exact depth is known and the rocks here can be compared with similar subsurface samples from Ohio and with samples of exposed Precambrian rocks to the east throughout the northern Appalachians. Events and processes that affected these rocks can be placed within a regional framework for a better understanding of the geologic history of the area, as well as its resources.

Information Circular 79 is available for $1.00 (plus sales tax) from the Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125.

THE GROUND-WATER PROGRAM FOR PENNSYLVANIA

The Pennsylvania Geological Survey has published a new edition of Information Circular 7, *The Ground-Water Program for Pennsylvania*. The 13-page pamphlet explains the history and purpose of the cooperative ground-water program between the Pennsylvania Geological Survey and the U. S. Geological Survey. Pennsylvania Survey publications that have resulted from the program are listed, and current and future projects are discussed briefly. IC 7 is available upon request from the Pennsylvania Geological Survey, Executive House Apartment Building, Second and Chestnut Streets, Harrisburg, Pennsylvania 17101.

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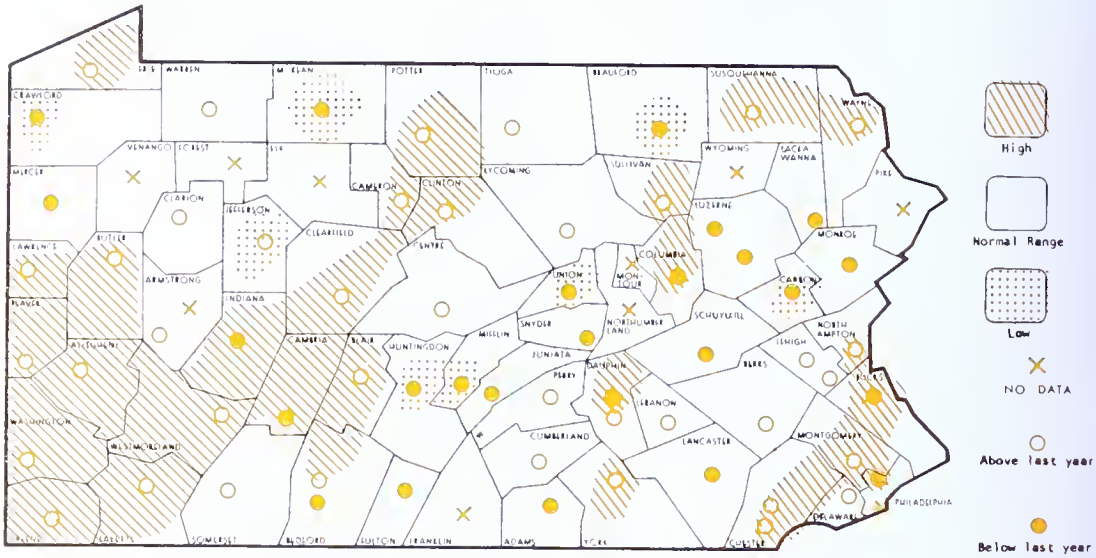
SEPTEMBER 1975

GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120

PENNSYLVANIA GEOLOGY

PENNSYLVANIA GEOLOGICAL SURVEY
VOL. 6/6

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

Cover Photo: Entrance to the Brooks Model Coal Mine in Nay Aug Park in east Scranton. The model mine is located near the Everhart Museum and is the only model coal mine in Northeastern Pennsylvania open to the public daily from 10:00 a.m. to 6:00 p.m.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

DECEMBER 1975

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

A MAN'S BEST FRIEND

The latest craze sweeping the country is a new kind of pet. Advertisements in major city papers feature "The pet rock, complete with travel case and training manual." Readers are urged to "give-a-rock-a-home" and are advised that the pet rock can be "trained to obey simple commands like Heel, Play dead, and Roll over."

As is so often the case, we must point out that again geologists have been ahead of the times! Geologists have long had pet rocks; many geologists have office shelves full of them, and some even take their special pets home. Certainly the geologist is a master at training his pets; on the shelf they never move, but on the hillside they roll over at the slightest prod of the geologic pick.

Speaking seriously, the esthetics of rocks and minerals have appealed to hundreds of thousands in all parts of the world. The mineral displays at museums large and small are prime attractions for visitors of all ages. Anyone who has experienced the beauty of the mineral collections at the Smithsonian Institute in Washington could not fail to be entranced.

Mineral collecting has become a tremendously widespread hobby. Individuals, entire families, and mineral clubs actively pursue the quest for mineral finds. There are few avocations which can match the challenge, the stimulation, and the healthful exposure of the search for minerals in the field.

Pennsylvania has long been a center of mineral collecting, with several world reknown collecting localities. The Pennsylvania Geological Survey's bulletin on Mineral Collecting in Pennsylvania is perennially our best seller; with the supply of the last printing exhausted, a revised edition is nearing completion and should be ready by spring.

Yes, they are urging pet rocks for the public. But so many of us in geology and mineral collecting already have our pets, and well trained too!

Arthur A. Socolow

Scranton's Mineral Heritage Preserved

by
William H. Bolles
Science Education Adviser
Department of Education

The economy of the Scranton area shifted from agriculture to mining during the 1840's due to the efforts of George and Selden Scranton. The mining of iron ore to be used in the production of rails was the first mineral industry. The Lackawanna Iron Furnaces on Cedar Avenue are the restored remains of the original iron furnaces built by George Scranton and associates as part of the Lackawanna Iron Company.

With the expansion of the railroads the Scrantons were quick to realize that the anthracite they used in their iron furnaces had great potential of its own. Attention became focused on the "black diamonds" which would shape the destiny of the city for the next 80 years.

Fig. 1. Restored remains of the Lackawanna Iron Company furnaces at Cedar Avenue off Lackawanna Avenue.

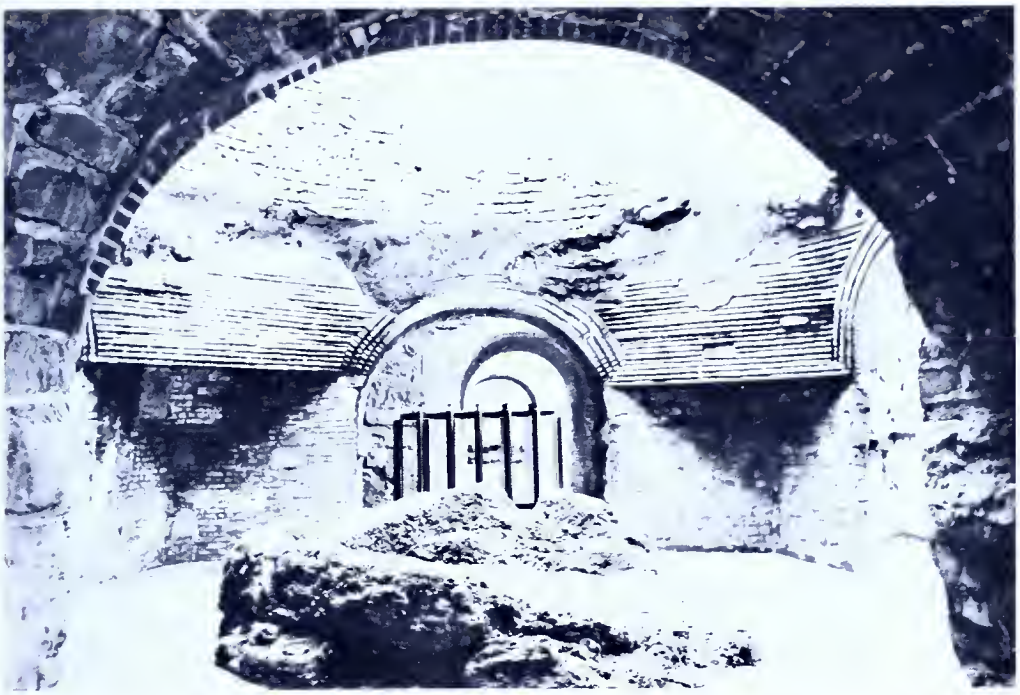


Fig. 2. Large mass of slag at the base of one of the restored furnaces.

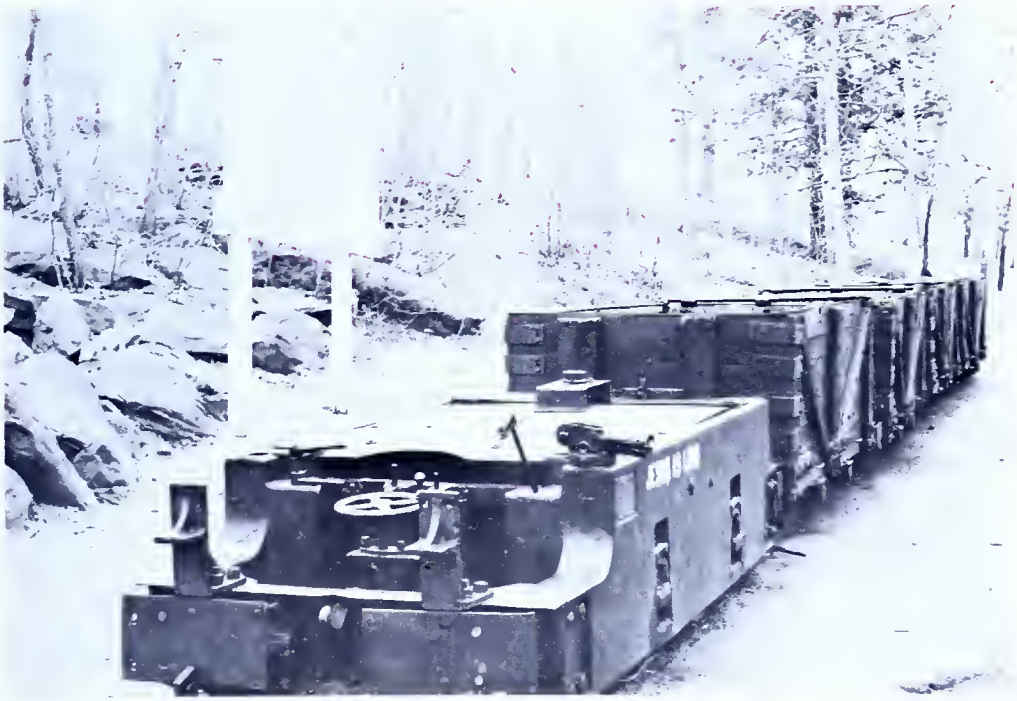


Fig. 3. Motor used to pull loaded coal cars from the mines.

Fig. 4. Interior view of the Brooks Model Coal Mine in Nay Aug Park near the Everhart Museum.

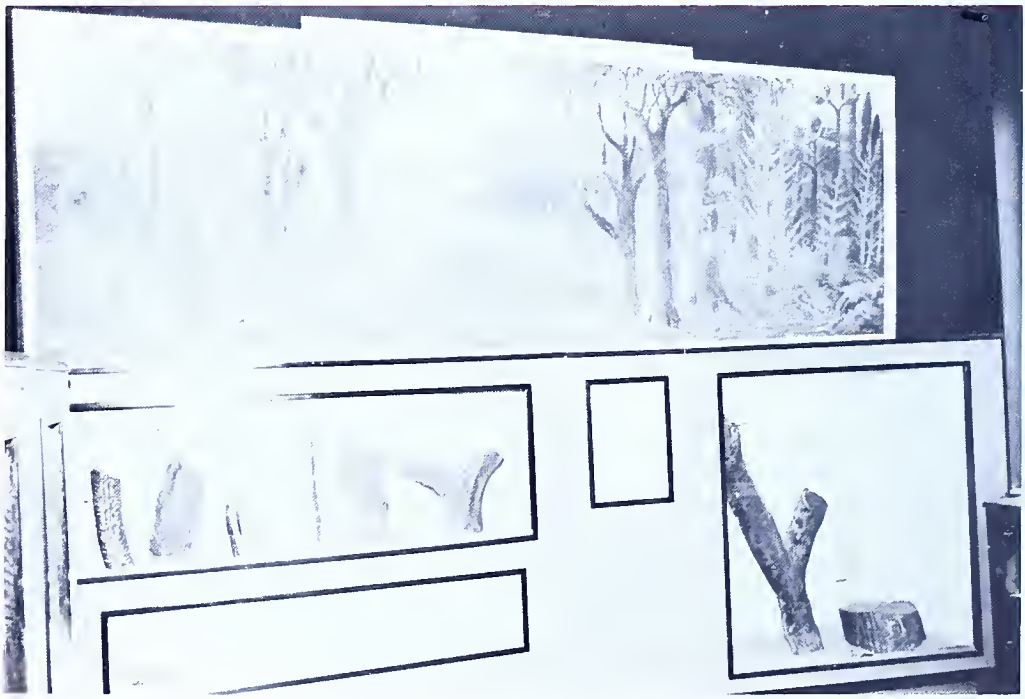


Fig. 5. View of the coal room in the Everhart Museum, Nay Aug Park, showing the origin of coal deposits.

The mining of coal escalated the area's industry, and in 1866 Scranton was incorporated as a city. The population grew from 30,000 in 1866 to 130,000 in 1910.

The Everhart Museum in Nay Aug Park contains a "coal room" where the local mining methods are shown as well as the origin of the area's coal deposits. A small mineral specimen display is located in the basement of the museum and about 1000 specimens are in their collection. The Brook's Model Coal Mine is located directly behind the museum and is open to the public daily from 10:00 AM to 6:00 PM.

All of these locations should be of interest to teachers and students in the study of local history and geology. With the renewed interest in coal as an energy source this local resource may again prove to be a boon to the Scranton area as well as the entire anthracite region.

GEOLOGY FOR PUBLIC USE

The U. S. Geological Survey has issued three new Professional Papers on applied aspects of geology that are particularly timely and relevant to present-day needs.

Earth Science in the Public Service, Professional Paper 921, presents a series of papers identifying various ways by which geology is serving contemporary problems in our society.

Mineral Resources Perspectives in 1975, Professional Paper 940, defines in simple language the status of the nation's vital mineral resources, and the outlook for fulfilling our future needs.

The Logic of Geologic Maps, With Reference to Their Interpretation and Use for Engineering Purposes, Professional Paper 837, strips geologic maps of their scientific mystique and explains how such maps can be valuable tools for community needs and decision making.

Professional Papers 921, 940, and 937 sell for $2.15, $.95, and $3.50 respectively, and may be purchased from the Branch of Distribution, U. S. Geological Survey, 1200 S. Eads St., Arlington, Virginia 22202.

The April 1975 issue of "Pennsylvania Geology," volume 6/2, pages 7 and 8, contain misspellings of the Devonian Echinoderm *Anomalocystites*. The correct spelling is Anomalocystites, not Anomolocystites.

AND THEN CAME ELOISE...

by
Arthur A. Socolow

For many residents of the Susquehanna River Basin the anguished memories of Hurricane Agnes' flooding of 1972 had only just begun to fade when along came the rains of Eloise in September, 1975. Little wonder, then, that with the early flood warnings while Eloise was in progress, one could look up and down the riverfront streets of Harrisburg and see the pitiful sight of residents desperately loading their precious possessions onto hauling vans, rented trailers, borrowed trucks, and station wagons. All this came so soon after the so-called "100-year" Agnes flood.

Fortunately, for most areas Eloise flooding did not reach the proportions of Agnes and much of the precautionary effort happily turned out to be unnecessary. But such was not true in all cases. Many

Along came Eloise and on September 27th Swatara Creek at Hershey decided to flow over the Sand Beach Road bridge, rather than under it!

At the Lyonsville Bridge north of Hershey, if you were following northbound route 743 you had better have an aquatic vehicle.

Paxton Creek in Wildwood Park near Harrisburg Area Community College; note mud-stained shrubbery marking flood level of the creek.

After the Eloise waters went down in the Shipoke area of Harrisburg, there remained the backbreaking job of debris cleanup, both inside and outside the homes.

The water impacts of Eloise extended to the subsurface, as well as the surface, as evidenced by this sinkhole development and resulting home damage.

of the tributaries of the Susquehanna River experienced water levels and flooding which equalled or exceeded Agnes. In the Harrisburg area, creeks like the Yellow Breeches, the Conodoguinet, and the Swatara each went on new rampages. Within the city, Paxton Creek again did its dirty work along Cameron Street. Fortunately, the Pennsylvania Geological Survey offices and labs are on the 8th and 9th floors in a center-city area untouched by flooding. As we of the Pennsylvania Geological Survey watched our former 1972 quarters again hit by Paxton Creek flooding, we had the satisfaction of having so wisely resisted the suggestion in 1972 that we reoccupy our once-flooded quarters after the Agnes debacle.

The agonies of flooding can never be totally eradicated. We can only hope that the public and its representatives at all levels of government will recognize that the problem will recur, and therefore such technological and procedural steps should be taken as to forestall and minimize the impacts.

OIL AND GAS, PENNSYLVANIA 1975

by
William S. Lytle

During the first nine months of 1975, there were 13 discoveries made in the Commonwealth. Of these 13, there were 4 deep gas, 8 shallow gas, and 1 shallow oil discoveries.

The shallow oil discovery was made in Vernon Township, Crawford County, where the No. 1-A Dwight L. Moody well had an initial production of 184 barrels of oil per day from the Second Venango sandstone at a depth of 622 feet. This well is in an area far from any other shallow oil or gas production. A couple of small fields had been productive of oil and gas in the early oil days, one 5 miles east and the other 5 miles south of this discovery. Although this small lens of sand will probably produce only a minor amount of oil and gas, it indicates that there are other possibilities of finding oil and gas in northwestern Pennsylvania beyond the known producing areas. Where there is one small lens of oil-bearing sandstone there can be much larger lenses in this area, where only a few wells have been drilled. The new field is not significant in itself, but it shows the potential for the area which is significant.

The first reported shale gas well in Pennsylvania was drilled in 1975 in Beaver County, on the Metropolitan Industries property. The well after fracturing of the Upper Devonian shale, had an initial production of 150,000 cubic feet of gas per day in the interval from 3500 to 4700 feet in depth. Shale gas wells generally fall off rapidly from their initial production but have very long lives. Currently interest is high for shale gas, and in the next few years we will see a number of wells testing the Upper Devonian shale section in search of gas in commercial quantities. From the blowouts encountered when drilling through this shale, we know there is considerable gas in the section. The question is—can a shale gas well be completed to produce in commercial quantities for several years? We know that shale gas wells in other states have been economically productive and we hope areas can be found in this state where the wells will be profitable.

The No. 1 R. J. Lambert well was drilled in Somerset County, discovering gas in the Oriskany sandstone at a depth of 8636 feet. This well discovered the Shanksville field with an initial production of 2500 MCFPD natural. As yet, no additional wells have been drilled in the field, but it could be developed into a fair-sized field.

The discovery of commercial gas-bearing Medina sandstone as far south as southern Venango County opened up all of northwestern Pennsylvania to the possibility of obtaining gas production from the Medina. Since then several manufacturing companies have been successful in drilling for Medina gas to supplement the gas they buy from the public utility companies or to be used in an emergency situation. N-Ren Corporation, a fertilizer manufacturing company, has taken over some wells drilled by Kebert Development and has launched on a many well drilling program of their own in an attempt to find enough gas to satisfy their requirements so they can build a new plant in the Meadville area. Many other companies outside of northwestern Pennsylvania have been active in trying to find gas to supply their needs when their supply is cut back this winter by the public utilities.

A well in McKean County, the No. 2 Minard Run Tract Wt. 2279 has discovered commercial gas in the Cambrian Little Falls Dolomite. The open flow was estimated at 500,000 cubic feet of gas per day at a rock pressure of 3000 psi in 48 hrs. The total depth of this well is 10,478 feet. An attempt was made to fracture this well, but the operators were not successful even with a fracturing pressure of almost 10,000 psi. Experimental work will continue with this well. The only other Cambrian production in Pennsylvania was from the Gatesburg sandstone in northwestern Pennsylvania, where two small fields produced a little gas before abandonment.

New Uranium-Thorium Occurrence in Northampton County

by Bob C. Smith II

As part of continuing activities of the Bureau of Topographic and Geologic Survey aimed at locating metamorphic type zinc deposits in Pennsylvania, the Easton area Chestnut Hill talc-serpentine quarries were recently examined. Only traces of zinc and lead were found, but uranium-thorium minerals were found to be common in an abandoned serpentine-talc quarry, located on the west side of Bushkill Gap through Chestnut Hill, 2000 feet N18°W of the 13th Street exit of U. S. Route 22 (latitude: 40° 42′ 00″, longitude: 75° 13′ 59″). The quarry is owned by Pfizer, Inc., 640 North 13th Street in Easton. Study of the unusually good exposures in this quarry may help locate other uranium occurrences in areas more favorable for mining.

Bedding in the contact-metamorphosed Precambrian Franklin marble trends N85°E, 42°S. Phlogopite-rich beds appear to be the richest in uranium and thorium. A 36-inch channel sample across a phlogopitic bed near the quarry floor assayed 0.1% U_3O_8 plus appreciable but undetermined amounts of Th. This bed is mineralized for at least 15 feet along the quarry face. Additional digging at a later date indicated that mineralization with a gamma activity greater than 0.3 mR/hr continues for at least an additional 12 inches into the quarry floor. Other mineralized zones in the quarry and on the north upper rim have surface activities from 0.12 to 1.3 mR/hr. Typical of many uranium occurrences, the exposed rock was found to be leached of uranium. Serpentine group minerals, phlogopite, tremolite, talc, thorian uraninite, thorogummite, and traces of zircon, chalcopyrite, galena, and pyrite have been identified. The occurrence is similar to those described by Montgomery (Am. Min., v. 42, p. 804–820).

FIELD CONFERENCE GUIDEBOOKS NEEDED

The Field Conference of Pennsylvania Geologists still needs copies of many years' guidebooks for its archival files. Original copies will be accepted with many thanks for the following years:

1 – 1931	7 – 1937	13 – 1947
2 – 1932	8 – 1938	15 – 1949
3 – 1933	9 – 1939	16 – 1950
4 – 1934	10 – 1940	23 – 1958
5 – 1935	11 – 1941	33 – 1968
6 – 1936	12 – 1946 (need only "Stratigraphic Sequence of Allegheny Front," by Swartz)	

SURVEY ANNOUNCEMENTS

GREATER PITTSBURGH REGION GEOLOGIC CONDITIONS AND RESOURCES

The surface and subsurface geologic conditions of the six county Greater Pittsburgh region, as well as the oil and gas fields of the area, are delineated and evaluated in four new sets of maps issued by the Pennsylvania Geological Survey. Together, these four packets of maps offer the most comprehensive assemblage of geologic data ever put together for the six heavily populated, industrialized counties centering on Pittsburgh: Allegheny, Washington, Beaver, Butler, Armstrong, and Westmoreland. This mapping program was supported in part by the U.S. Geological Survey.

Map #42 is "Greater Pittsburgh Region Geologic Map and Cross Sections," by Walter Wagner and associates. This full-color geologic map is accompanied by three large plates showing cross sections, coal formations, and drill hole data. The accompanying text and legend describes the environmental aspects and groundwater characteristics of each formation in the area; the economic potential landslide susceptibility and engineering characteristics are itemized. Map #42 sells for $8.60.

Map #43 is the "Greater Pittsburgh Region Structure Contour Map," by Walter Wagner and colleagues. This map shows by contour lines the configuration (or warping) of the rock layers in the six-county area. This enables engineers, mineral developers, subsurface water seekers, and planners to know where at depth is the formation of their respective interests. Map #43 is priced at $1.75.

Map #44 is the "Greater Pittsburgh Oil and Gas Fields Map," by William Lytle and Lajos Balogh. While most people think of the Drake Well in Crawford County and Oil City in Venango County when Pennsylvania oil is mentioned, the six-county Greater Pittsburgh area is an old, established producing area with 245 named oil and gas fields and pools. Some of these have also been used as secondary gas storage reservoirs. At this time of energy shortage, with increased oil and gas exploration and development, it is essential that the Pittsburgh area fields be identified for proper planning and protection. Map #44 sells for $3.70.

An important contribution to engineering and construction design is offered by Map #45, "Greater Pittsburgh Region Maps of Mined-

Our Areas and Thickness of Rocks Over the Pittsburgh Coal," by Mr. Sam Cortis and colleagues. Much of the six-county area is underlain by the world-famous Pittsburgh Coal Seam, and large portions of this coal seam have been removed by deep, underground mining. The two large maps in this packet show (1) where the Pittsburgh Coal Seam has actually been mined out, and (2) what the thickness of rock is between the surface and the mined-out zone at depth. This combined information is vital when planning any surface or subsurface construction; it enables the engineer to evaluate the subsidence potential over a mined-out location, and, thus, plan whatever engineering steps are needed to cope with the situation. Planners, zoners, and residents of the area will all benefit from this information. Map #45 is priced at $1.85.

These important four map packets may be ordered at the indicated prices (plus 6% sales tax for Pennsylvania residents) from the Pennsylvania Bureau of Publications, P.O.Box 1365, Harrisburg, Pa. 17125.

NEW REPORTS ON CARBON AND MONROE COUNTY GEOLOGY

Major progress has been achieved in defining the geology and mineral resources of Carbon and Monroe counties with the release of three new Atlas reports by the Pennsylvania Geological Survey. The new reports provide critical environmental data for an area of growing population and increased recreational facilities. It is an area where protection and wise use of the environment call for all possible basic data.

Authored by Staff Geologist Dr. William D. Sevon, the three new geologic reports cover six quadrangles as follows:

Atlas 194 cd, Geology and Mineral Resources of the Hickory Run and Blakeslee Quadrangles.

Atlas 195 ab, Geology and Mineral Resources of the Christmans and Pohopoco Mountain Quadrangles.

Atlas 204 ab, Geology and Mineral Resources of the Tobyhanna and Buck Hill Falls Quadrangles.

Each Atlas report includes a text and two detailed, full-color maps, one of the bedrock geology and one of the occurrence of unconsolidated glacial deposits. Particular attention is given on the maps and in the text to enumerate the environmental characteristics of the geological formations, including their potential as mineral resources, their properties which affect excavation and construction, and their utility for water resources and waste disposal.

The three new reports will be of interest to Northeastern Pennsylvania planners, engineers, developers, sportsmen, and area residents with an interest in their geologic environment. Geologists will benefit from the new knowledge of geologic processes and events of the area.

The reports are available from the Pennsylvania Bureau of Publications, P.O. Box 1365, Harrisburg, Pa. 17125. The prices are: Atlas 194 cd $9.10; Atlas 195 ab $11.20; Atlas 204 ab $10.10. Pennsylvania residents should add 6% sales tax.

MONROE COUNTY SAND AND GRAVEL STUDY ON OPEN FILE

The Pennsylvania Geological Survey is placing on open file the results of a preliminary study by Joseph P. Fox on the sand and gravel resources of Monroe County. Sampling and analyses of thirty sand and gravel deposits, mostly of glacial origin, were carried out while Mr. Fox was a student intern with the Survey, during the spring of 1974. This open file report includes gradations of the naturally-occurring materials, along with several physical tests including Los Angeles abrasion tests and freeze-thaw tests. Complete pebble counts were done on the gravels, and compositional estimates were made on the sands. The report includes a 1:62,500 sample location map and one hundred ninety-eight text pages with polaroid photographs, colored pie diagrams, histograms, and original field and lab notes.

Because of the complexity of this report, it is not readily reproducible, but may be examined at the Harrisburg offices of the Pennsylvania Geological Survey, Room 914, Executive House, 101 S. Second Street, Harrisburg, Pennsylvania.

New From the U.S. Geological Survey

Professional Paper 924 Hurricane Agnes rainfall and floods June-July, 1972. by J. F. Bailey, J. L. Patterson and J. L. Paulhus. 1975. $9.10

Hydrologic information is given on the June-July 1972 floods in New York, Pennsylvania, Maryland, Virginia, North Carolina and West Virginia resulting from the passage of Hurricane Agnes. The

detailed life history of the storm is traced, and rainfall information is shown for selected sites. Peak stages and discharges, flood frequency, and sediment data are given for 989 stations.

Hydrologic Investigation Atlas HA-541 Flood of June 22-23, 1972 at Lock Haven, Pa., by H. N. Flippo, Jr. 1975. $1.00

The area inundated by the flood of June 22-23, 1972, is shown on the topographic base map. Flood-frequency relations are given for both natural flows and regulated flows of West Branch Susquehanna River and for natural flows of Bald Eagle Creek. Flood profiles are shown for the 1936 and 1972 floods.

Map I-917A Oil and Gas Data from the Upper Paleozoic Rocks in the Appalachian Basin by W. de Witt, Jr.

Map I-917B Oil and Gas Data from the Devonian and Silurian Rocks in the Appalachian Basin by W. de Witt, Jr., W. J. Perry, Jr., and L. G. Wallace.

The maps, charts, and cross sections contained in 917 A and B are a survey of the subsurface data on the oil and gas resources of the Appalachian Region (including Pennsylvania). They are intended to serve as summary materials to aid in the search for additional supplies of oil and gas.

Map I-801 Geologic Map of the Beans Cove and Hyndman Quadrangles and part of the Fairhope Quadrangle, Bedford County, by W. de Witt, Jr.

Miscellaneous Field Studies Map MF-685-A Maps of rock types in bedrock of Allegheny County, Pennsylvania, by W. R. Kohn. 1975. (scale 1:50,000)

Miscellaneous Investigations Series Map I-809 Geologic map of anthracite-bearing rocks in the Tamaqua quadrangle, Carbon and Schuylkill Counties, Pennsylvania. by G. H. Wood, Jr. 1975. (scale 1 inch = 1,000 feet)

Maps 917 A and B are available for $2.00 each; Map I-801 and MF-685-A are available for $1.00, Map I-809 for $1.50, by writing to:

U.S. Geological Survey
Washington Map Distribution Section
1200 S. Eads Street
Arlington, Va. 22202

New Molybdenite Occurrence in Berks County

by Bob C. Smith, II

Molybdenite, a metallic bluish-gray sulfide ore mineral of molybdenum, has been found as flakes up to ¾ inch across in a roadcut near Reading. The occurrences are not of economic size, but identify the general area as one which may be mineralized with other important metallic elements. This occurrence was brought to our attention by a friend of the Survey for the benefit of mineral collectors.

Several molybdenite occurrences are scattered in a relatively new roadcut from 290 to 605 feet south-southeast of the breast of Ohlinger Dam for Antietam Reservoir, Stony Brook Mills, Berks County (latitude 40°21'20"N longitude 75°52'10"W). About 290 feet from the dam, a 2–4" wide molybdenite-bearing dike trends roughly N45E dipping 70°NE. The dike is composed of plagioclase and quartz, with minor amounts of biotite, hornblende and pyrrhotite.

The molybdenite is sparsely distributed along the dike margins. This molybdenite is of the 2H polytype and alters to sparse, pseudomorphs of powellite. The powellite is highly fluorescent (cream to yellow) with short-wave ultraviolet light. This is the first verified occurrence of powellite in Pennsylvania.

A larger, irregular, gray molybdenite-bearing pegmatite dike occurs from 445 to 495 feet southeast of the dam. Molybdenite flakes here range up to ¾ inch in size and were originally sufficiently abundant so as to be visible from a slowly moving car! About 605 feet from the dam, a pyrite-rich, finer-grained granitic rock is rich in disseminated molybdenite. A sample consisting of ten pounds of typical 1-inch chips from the outcrop was found to contain 0.15% molybdenum, 0.05% copper, 0.06% zinc, 270 ppm nickel, 110 ppm lead, 60 ppm cobalt, and traces of gold and silver. Weathering of the abundant pyrite has coated parts of this outcrop with yellowish-brown jarosite, a hydrous potassium iron sulfate.

In addition, a trace of molybdenite occurs in the roadcut northeast of the dam. D'Invilliers' 1883 report on the geology of Berks County listed molybdenite from the roadcut west of the dam and Valentine Hartman's mine north of the reservoir. The presence of minor amounts of molybdenite at several places near Antietam Reservoir suggests that this area should be checked for other high temperature hydrothermal minerals.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

Arthur A. Socolow, *State Geologist*
Donald M. Hoskins, *Assistant State Geologist*

TECHNICAL SERVICES

Shirley J. Barner, *Stenographer*
Sandra Blust, *Librarian*
Joanne Bowman, *Typist*
John G. Kuchinski, *Draftsman*
Christine Miles, *Geological Editor*
Virginia Milewski, *Draftsman*
Mary A. Miller, *Stenographer*
Marjorie Steel, *Stenographer*
Albert Van Olden, *Draftsman*
John H. Way, Jr., *Geological Editor*

ENVIRONMENTAL GEOLOGY DIVISION

Alan R. Geyer, *Division Chief*

Jesse Craft, *Geologist* (Pittsburgh Office)
Eugene H. Hess, *Geologist*
Evan T. Shuster, *Geologist*
Donna M. Snyder, *Stenographer*
Grace Tyson, *Clerk*
John P. Wilshusen, *Geologist*

GEOLOGIC MAPPING DIVISION

Samuel I. Root, *Division Chief*

Thomas M. Berg, *Geologist*
William E. Edmunds, *Geologist*
Rodger T. Faill, *Geologist*
Albert D. Glover, *Geologist*
Jon D. Inners, *Geologist*
David B. MacLachlan, *Geologist*
Phyllis Ritter, *Typist*
William D. Sevon, *Geologist*
Mark A. Sholes, *Geologist*
Viktoras W. Skema, *Geologist*
Richard B. Wells, *Geologist*

MINERAL RESOURCES DIVISION

Bernard J. O'Neill, *Division Chief*

John H. Barnes, *Geologist*
John C. Benson, *Typist*
Leslie T. Chubb, *Laboratory Technician*
Robert C. Smith, *Geologist*

OIL AND GAS DIVISION

1201 Kossman Bldg.
100 Forbes Ave., Pittsburgh, Pa. 15222
William S. Lytle, *Division Chief*

Lajos Balogh, *Draftsman*
Cheryl Cozart, *Stenographer*
Elizabath A. Eberst, *Typist*
Robert Fenton, *Laboratory Technician*
Louis Heyman, *Geologist*
Robert G. Piotrowski, *Geologist*

TOPOGRAPHIC DIVISION

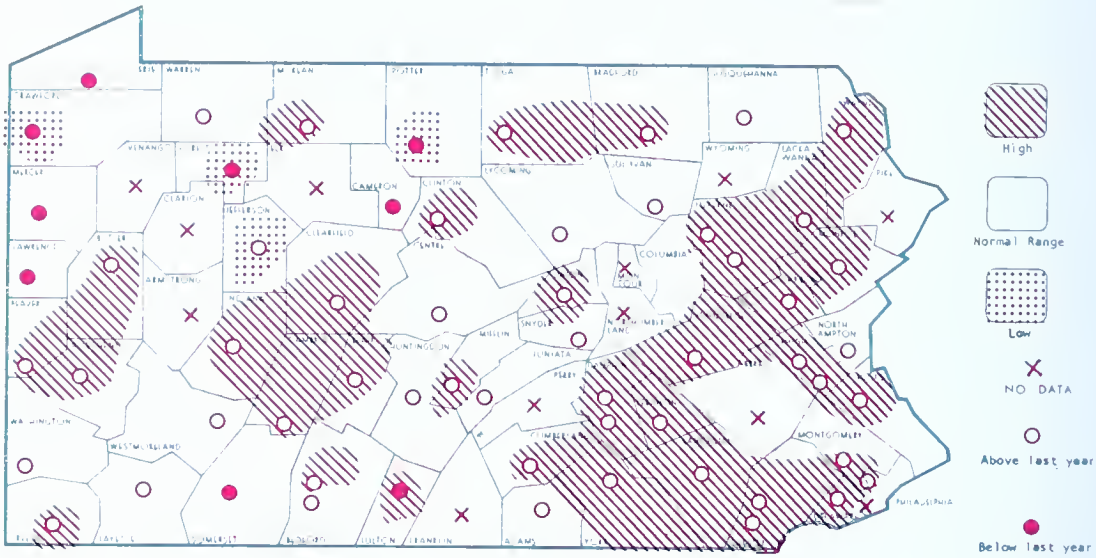
In Cooperation with The U.S. Geological Survey

GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

NOVEMBER 1975

GROUND-WATER LEVELS



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120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